II Biennial NOXIOUS PLANTS Conference

NEW ENGLAND UNIVERSITY
ARMIDALE N.S.W. APRIL 17-22, 1983

NEW SOUTH WALES
DEPARTMENT OF AGRICULTURE

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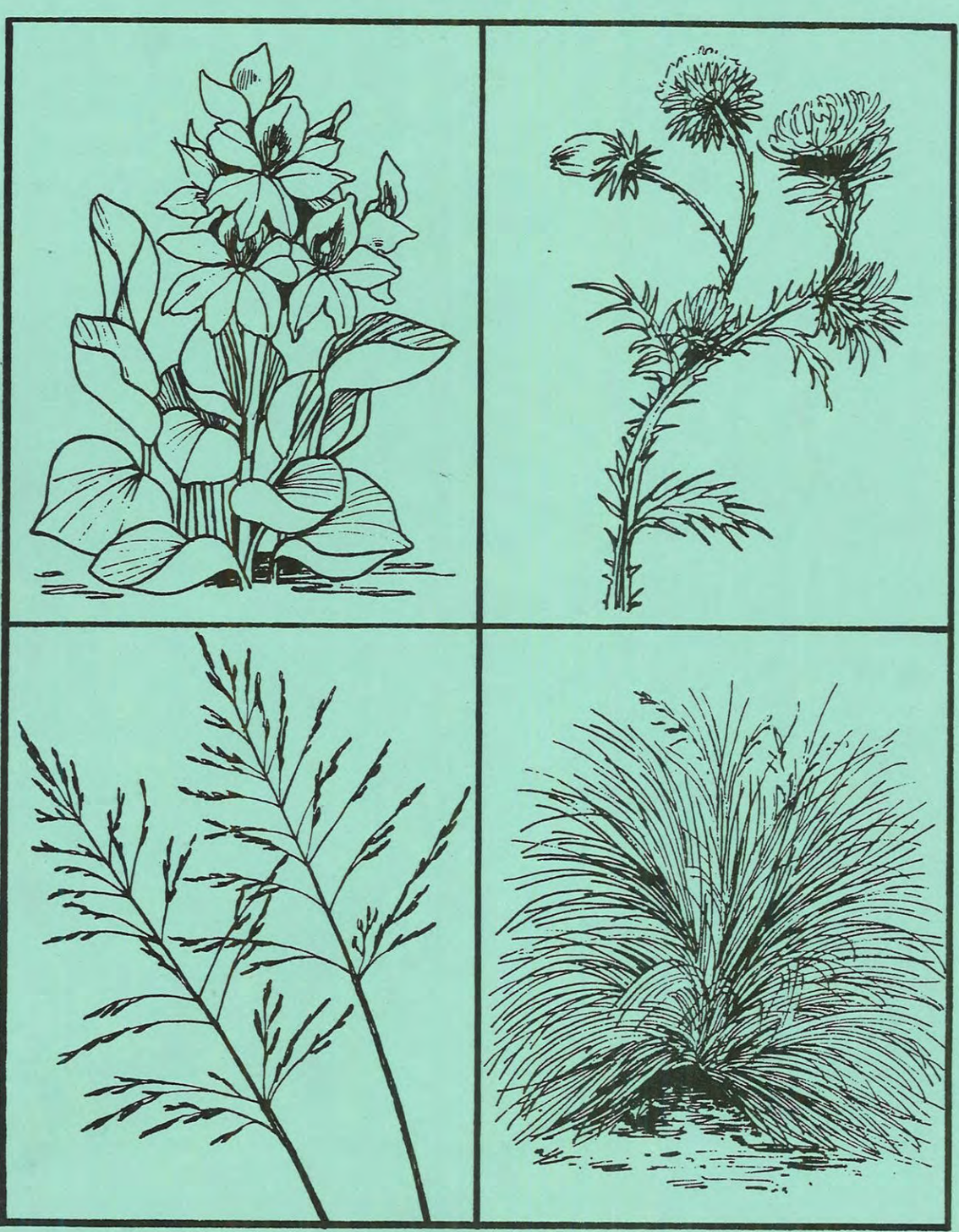

CONTENTS

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SECOND BIENNIAL NOXIOUS PLANTS CONFERENCE

Derek Brown,
Field Officer (Weeds), Tamworth.
Conference Convenor.

The Biennial Noxious Plants Conferences are conducted by the Department of Agriculture, New South Wales, for Local Government, Government Departments and others who have direct responsibilities for noxious plant control in New South Wales. In alternative years, throughout the State, the Department of Agriculture conducts Regional Seminars. These activities are just some of the responsibilities the Department has to these authorities, in advising and keeping them fully informed of all new developments and trends in noxious plant control.

This statewide conference on noxious plants is the first to be held in Northern New South Wales. As such, it lends itself to the broadening of perspective of all who attend. The conference is conducted under the auspices of Dr. Allan N. Smith, Regional Director of Agriculture, New England, Hunter and Metropolitan Region, Gunnedah, and Dr. Leon W. Smith, Chairman, Noxious Plants Advisory Committee, Principal Agronomist (Weeds), Sydney.

The conference theme "Noxious Plants - The Future Challenges and Trends" creates the awareness of a need for everyone to be responsive to the challenges and perhaps redirection necessary to achieve positive noxious plant control management throughout the State.

The Department of Agriculture gratefully acknowledges the support of the Local Government Weeds Officers and their Councils, who have participated on the Conference Planning Committee and to New England Tablelands County Council who is host council for this conference. We also thank those commercial companies who have given their generous sponsorship and assistance in the conference activities.

Additional appreciation and thanks is extended to all participants involved in the conducting and presenting of the conference proceedings.

Finally, we thank you for your attendance. We trust that the knowledge and information gained from your participation will be of practical benefit to you.

CONFERENCE PLANNING COMMITTEE

Chairman:	*Dr. Leon W. Smith,*	*Department of Agriculture, Sydney.*
	Don Armstrong,	*Far North Coast County Council, Casino.*
	Ron Baker,	*Narrabri Shire Council.*
	Jim Cherry,	*Central Northern County Council, Quirindi.*
	Greg Collyer,	*Gunnedah Shire Council.*
	Graham Mathews,	*Bellingen Shire Council.*
	Kevin Waters,	*New England Tablelands County Council, Armidale.*
	Clive Willmott,	*Moree Plains Shire Council.*
	Jim Dellow,	*Department of Agriculture, Orange.*
	John Ryan,	*Department of Agriculture, Glen Innes.*
	Peter Gorham,	*Department of Agriculture, Cowra.*
	Peter Gray,	*Department of Agriculture, Dubbo.*
Proceedings Editor:	*Hugh Milvain,*	*Department of Agriculture, Leeton.*
Convenor:	*Derek Brown,*	*Department of Agriculture, Tamworth.*

S P O N S O R S

ROCHE-MAAG	-	*Speaker: Mr. Des Thwaires, Management Consultant, Sydney.*
DUPONT	-	*Trophy and Prize, Innovative Ideas Competition.*
NOXIOUS PLANTS ADVISORY COMMITTEE	-	*Award for Best Presented Innovative Ideas.*
INKATA PRESS	-	*Highly Commended Awards, Innovative Ideas Competition.*
DOW AUSTRALIA LTD	-	*Conference Satchel*
MONSANTO AUST. LTD	-	*Conference Note Folder.*
NETCC & WALCHA SHIRE	-	*Bus Trip: Morning Tea at Walcha.*

SUB-COMMITTEES

House Committee	-	*Clive Willmot, Don Armstrong, Ron Baker, Graham Mathews.*
Dinner Committee	-	*Kevin Waters, Derek Brown.*
Bus Trip	-	*Kevin Waters, Jim Cherry.*
Session Chairman	-	*Greg Collyer.*
Audio Visuals	-	*Peter Gorham, Peter Gray.*
Registrations	-	*Derek Brown, Jim Cherry, Ron Baker, Kevin Waters.*
Innovative Ideas Comp.	-	*Peter Gray.*
Displays/Exhibits	-	*Derek Brown, Peter Gorham.*

2ND BIENNIAL NOXIOUS PLANTS CONFERENCE

MONDAY, 18TH APRIL, 1983

"Drug Plants as Noxious Plants"

SESSION CHAIRMAN, CEC WEBB, WEEDS OFFICER, WELLINGTON SHIRE

8.00 am	*LATE REGISTRATIONS*
9.30 am	*MORNING TEA*
10.00 am	*WELCOME TO REGION* *Dr Allan N. Smith, Regional Director of Agriculture.*
10.10 am	*WELCOME* *Mr Joe Georges, Chairman, N.E.T.C.C., Armidale.*
10.20 am	*OPENING ADDRESS* *Mr George H. Knowles, Director General of Agriculture, Sydney.*
10.50 am	*CONTROLLING DRUG PLANTS UNDER THE NOXIOUS PLANTS ACT - THE PROBLEMS* *Hugh Milvain, Field Officer (Weeds), Department of Agriculture, Leeton.*
11.05 am	*CONTROLLING DRUG PLANTS UNDER THE NOXIOUS PLANTS ACT - DEPARTMENT OF AGRICULTURE APPROACH* *Dallas Parsons, District Agronomist, Department of Agriculture, Moree.*
11.20 am	*CONTROLLING DRUG PLANTS UNDER THE NOXIOUS PLANTS ACT - LOCAL GOVERNMENT APPROACH* *Don Armstrong, County Weeds Officer, F.N.C.C.C., Casino.*
11.40 am	*POLICE DRUG SQUAD - THE TOTAL PROBLEM* *Senior Constable Frank Hansen, Drug Squad, N.S.W. Police Force, Sydney.*
12.15 pm	*QUESTION PANEL OF ABOVE SPEAKERS*
12.30 pm	*LUNCH*

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"Legal Requirements in Perspective"

SESSION CHAIRMAN, DEREK BROWN, FIELD OFFICER (WEEDS), DEPARTMENT OF AGRICULTURE, TAMWORTH

1.30 pm	*LEGAL PROBLEMS AT THE WORKFACE* *Bob Leach, C.W.O., Snowy River Shire, Berridale*
2.00 pm	*LEGAL ASPECTS* *Andrew Kaye, Solicitor, Quirindi.*
2.30 pm	*LEGAL ASPECTS* *Alan Russel, Solicitor, Department of Agriculture, Sydney.*
3.00 pm	*QUESTION PANEL OF ABOVE SPEAKERS*
3.30 pm	*AFTERNOON TEA*
4.00 pm	*PESTICIDES AND ENVIRONMENTAL PROTECTION* *Dr John Chapman, Pollution Control Commission, Sydney.*
4.30 pm	*AN OVERVIEW OF THE VARIOUS ACTS AFFECTING NOXIOUS PLANT CONTROL* *Alan Russell, Solicitor, Department of Agriculture, Sydney.*
5.10 pm	*QUESTION PANEL OF ABOVE SPEAKERS*
5.30 pm	*CLOSE*

TUESDAY, 19TH APRIL, 1983

*"Co-ordinated Projects - N.P.A.C. -
Department of Agriculture Initiatives"*

SESSION CHAIRMAN, PETER GRAY, FIELD OFFICER (WEEDS), DEPARTMENT OF AGRICULTURE, DUBBO

8.30 am	*PARTHENIUM WEED* *Clive Willmot, Weeds Officer, Moree Plains Shire.*
8.40 am	*SERRATED TUSSOCK* *Steve Dickman, Weeds Officer, Wingecarrabee Shire, Moss Vale.*
9.00 am	*ALLIGATOR WEED* *Brian Charlton, Willow Tree.*
9.20 am	*GROUNDSEL BUSH* *Don Armstrong, C.W.O., F.N.C.C., Casino.*
9.30 am	*NEW DIMENSIONS IN NOXIOUS PLANT CONTROL* *Dr Leon W. Smith, Principal Agronomist (Weeds), Sydney.*
10.00 am	*MORNING TEA*

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"Pesticides in Perspective"

SESSION CHAIRMAN, KEVIN WATERS, C.W.O., N.E.T.C.C., ARMIDALE

10.30 am	*OPERATOR HYGIENE AND SAFETY* *Jack Whitely, Weeds Officer, Scone Shire.*
10.40 am	*THE HAZARDS OF HERBICIDES* *Harvey Baker, Senior Chemist (Pesticides), Biological and Chemical Research Institute, Rydalmere.*
11.20 am	*PESTICIDES - SPILL ASPECTS AND DISPOSAL PROBLEMS* *Laurie Greenup, Director, Pesticides and Environmental Studies, Department of Agriculture, Sydney.*
11.50 am	*MANAGEMENT PROBLEMS ENCOUNTERED BY WEEDS OFFICERS* *Des Thwaites, Management Consultant, Sydney.* ** Sponsored by Roche-Maag Ltd.*
12.30 pm	*LUNCH*

TUESDAY, 19TH APRIL, 1983

"Management Techniques and New Technology"

SESSION CHAIRMAN, PETER GORHAM, FIELD OFFICER (WEEDS) DEPARTMENT OF AGRICULTURE, COWRA

1.30 pm *PRACTICAL COMPUTER USE*
Jim Cherry, C.W.O., C.N.C.C., Quirindi.

1.40 pm *PRACTICAL COMPUTER USE*
Ron Baker, Weeds Officer, Narrabri Shire.

1.50 pm *COMPUTERS IN PERSPECTIVE*
Mike Bryant, Economist, Department of Agriculture, Gunnedah.

2.30 pm *LANDSAT - A TOOL IN WEED MANAGEMENT*
Keith McCloy, Principal Officer (Remote Sensing), Department of Agriculture, Sydney.

3.00 pm *AFTERNOON TEA*

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"Introduction to New Technology"

SESSION CHAIRMAN, KEN HAYES, WEEDS OFFICER, COFFS HARBOUR SHIRE

3.30 pm *MANAGEMENT PRACTICES*
Des Thwaites, Management Consultant, Sydney.
** Sponsored by Roche-Maag.*

4.15 pm *ALLELOPATHY - SELF DEFENCE BY WEEDS*
Judy Levet, U.N.E., Armidale.

5.00 pm *SUMMARY BLACKBERRY CONTROL TRIALS IN N.S.W.*
Barney Milne/Jim Dellow, Department of Agriculture, Orange.

5.15 pm *PRE-BUS TRIP BRIEFING*
Derek Brown, Department of Agriculture, Tamworth.

5.30 pm *CLOSE*

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8.00 PM *WEEDS OFFICERS ASSOCIATION MEETING*

WEDNESDAY, 20TH APRIL, 1983

Conference Bus Trip

CO-ORDINATORS: KEVIN WATERS, C.W.O., N.E.T.C.C., ARMIDALE
JIM CHERRY, C.W.O., C.M.C.C., QUIRINDI

8.00 am sharp	*EX U.N.E. EN BUS FOR WALCHA VIA URALLA*
8.45 am	*WALCHA - NODDING THISTLE TRIAL. N.E.T.C.C., ARMIDALE*
9.30 am	*MORNING TEA* *(Compliments of Walcha Shire and N.E.T.C.C.)*
9.45 am	*EX WALCHA. EN BUS FOR NEMINGHA VIA WALCHA ROAD AND BENDEMEER*
11.00 am	*NEMINGHA ROADSIDE MANAGEMENT DEMONSTRATION:* *TECHNIQUES-METHODS-EQUIPMENT-PASTURE-ROPEWICKS* *Speakers:* *Terry Launders, Research Agronomist, Department of Agriculture, Taree.* *Warren McDonald, Special Agronomist, (Pastures), Department of Agriculture, Tamworth.* *Jim Cherry, C.W.O., C.N.C.C., Quirindi.*
12.30 pm	*LUNCH* *Barbecue, Agricultural Research Centre, Tamworth.*
1.30 pm	*INSPECTION OF PRICKLY PEAR DESTRUCTION COMMISSION'S BIO CONTROL FACILITY* *Speakers:* *Garry Ryan, Commissioner, P.P.D.C., Tamworth.* *Dr John Hoskins, Entomologist, P.P.D.C., Tamworth.*
2.15 pm	*EX T.A.R.C. EN BUS FOR BLACKBERRY TRIAL SITES - MOONBI*
3.00 pm	*MOONBI - BLACKBERRY TRIAL 1. "HERBICIDES - COSTS FOR AREA OF TREATMENT"* *C.N.C.C. and Chemical Companies, Scone Shire.*
4.00 pm	*MOONBI - BLACKBERRY TRIAL 2. "CONTROL TECHNIQUE USING HERBICIDES AND ALTERNATIVE METHODS".* *Department of Agriculture, C.N.C.C.*
5.30 pm/ 6.00 pm	*U.N.E. ARMIDALE*

BUS TRIP NOTES

THURSDAY, 21ST APRIL, 1983

"Aerial Techniques"

SESSION CHAIRMAN, GREG COLLYER, WEEDS OFFICER, GUNNEDAH SHIRE

8.15 am	*USE OF HELICOPTERS IN BLACKBERRY CONTROL* *Ron Nalder, C.W.O., Cabonne Shire, Molong.*
8.30 am	*HERBICIDE TECHNIQUES USING ROTARY WINGED AIRCRAFT* *Tony McLellan, East Coast Helicopters.*
9.15 am	*AERIAL APPLICATION TECHNIQUES* *Dr Malcolm Campbell, Senior Research Scientist, Department of Agriculture, Orange.*
10.00 am	*MORNING TEA*

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"SRA - New Techniques and Developments"

SESSION CHAIRMAN, GRAHAM MATHEWS, WEEDS OFFICER, BELLINGEN SHIRE

10.30 am	*ROPEWICKS* *Richard Walker, District Agronomist, Department of Agriculture, Wellington.*
10.50 am	*SRA - RESUME OF DEVELOPMENTS* *Alex McLennan, Agronomist, SRA, Sydney.*
11.00 am to 12.30 pm	*SRA - DEMONSTRATION* *Armidale Freight Yards.*
12.30 pm	*LUNCH*

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THURSDAY, 21ST APRIL, 1983

"Problem Areas of Weed Control"

SESSION CHAIRMAN, JOHN FITZGERALD, WEEDS OFFICER, N.E.T.C.C., ARMIDALE

1.30 *URBAN WEED CONTROL*
Dr Leon Smith, Principal Agronomist (Weeds), Department of Agriculture, Sydney.

2.00 pm *BRUSH AND SCRUB CONTROL IN WESTERN LANDS USING RESIDUAL HERBICIDES*
Bruce Alchin, Research Officer, Western Lands Commission, Sydney.

2.30 pm *ROCHE-MAAG PRESENTATION: "COMPUTERISED HERBICIDE FILE"*
Bruce Howie, Roche-Maag, Sydney.

3.00 pm *MONSANTO PRESENTATION: ROUNDUP (R) HERBICIDE - USES + WIPER EQUIPMENT*
Rob Anderson, District Manager, Monsanto, Tamworth.

3.30 pm *AFTERNOON TEA*

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"Commercial Presentation"

SESSION CHAIRMAN, JACK DALEY, WEEDS OFFICER, HAWKESBURY RIVER COUNTY COUNCIL, CASTLE HILL

4.00 pm *DUPONT PRESENTATION: RESIDUAL HERBICIDE USE FOR NOXIOUS PLANT CONTROL*
Geof Jacobs, Dupont, Sydney. Bernie Horsfield, Dupont, Brisbane.

4.30 pm *DOW PRESENTATION: GARLON + TORDON HERBICIDES FOR BLACKBERRY, GORSE AND SWEET BRIAR CONTROL*
Alan Murphy, Senior Research Agronomist, Dow Aust., Sydney.

5.00 pm *CLOSE*

FRIDAY, 22ND APRIL, 1983

"Biological Control Review"

SESSION CHAIRMAN, NEV AKEHURST, WEEDS OFFICER, F.N.C.C.C., CASINO

8.00 am to 9.15 am	*EQUIPMENT EXHIBITS - DELEGATES CAN MEET WITH REPRESENTATIVES*
9.30 am	*BIOLOGICAL CONTROL - TERRESTRIAL WEEDS* *Dr Ernest Delfosse, C.S.I.R.O., Canberra.*
10.00 am	*MORNING TEA*

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"Noxious Plants Policy and Administration"

SESSION CHAIRMAN, KEN BUNNS, WEEDS OFFICER, PORT STEPHENS SHIRE, RAYMOND TERRACE

10.30 am	*BIOLOGICAL CONTROL - AQUATIC WEEDS* *Dr Ken Harley, Senior Principal Research Scientist, C.S.I.R.O., Brisbane.*
11.00 am	*NOXIOUS PLANTS ADVISORY COMMITTEE POLICY AND DIRECTION* *Dr Leon Smith, Chairman, N.P.A.C., Sydney.*
11.30 am	*GRANT APPLICATION* *Joe Poulter, Secretary, N.P.A.C., Sydney.*
12.00 noon	*CONFERENCE EVALUATIONS AND SUMMARY*
12.30 pm	*LUNCH AND CLOSE*

Director-General's Opening Address - 2nd Biennial Noxious Plants Conference for Local Government - University of New England - 18th April, 1983

I am pleased to be with you again on the occasion of your 2nd Biennial Noxious Plants Conference here at the University of New England and I am honoured to have been asked to open your conference.

In these trying times it is gratifying to see the attendance of so many delegates representing Local Government and other organisations from throughout the state.

As this is the first occasion when interstate delegates have been invited to the conference, I extend a warm welcome to those representing Queensland authorities and trust that you will find this conference of benefit to you.

Although Regional Noxious Plant Seminars were initiated and developed in the New England area, this is the first occasion that a statewide Noxious Plants Conference has been conducted in northern New South Wales.

The problems of noxious plant control in this area differ from elsewhere in the state and this conference will broaden the perspective, knowledge and ability of all those attending it.

In controlling noxious plants we can no longer afford to approach today's problems with the narrow single-mindedness of the past. It has become essential that Weeds Officers expand their knowledge and expertise in all noxious plant control matters.

Councils must also be prepared to recognise the value of their Weeds Officers and to develop positive noxious plant policies and programmes.

The State Government is allocating some $2.5 million annually as grants to assist Local Government to control noxious plants in New South Wales.

Unfortunately, these grants are not always being utilized in the spirit in which they are allocated. Too many Councils still use grants as criteria to justify how much they will spend on noxious plant control.

I must emphasise that, irrespective of State Government funding, Local Government authorities currently have the total responsibility for controlling noxious plants.

Grant funding is not a right or merely a matching grant; it is given as an incentive for Local Government authorities to develop sound programmes.

In 1981, a working party was established by the Hon. J. R. Hallam, Minister for Agriculture and Fisheries, to review noxious plant legislation, administration and management throughout the state.

The Ministers for Agriculture, and Local Government and Lands are now reviewing the working party's findings and an announcement on them is imminent. To stand still is to go backwards, it is therefore inevitable that changes will take place in the foreseeable future.

The noxious plant legislation in this state is some 63 years old and unfortunately it is not keeping pace with the requirements of modern agriculture. With new herbicides, modern equipment and new techniques, there is a totally new spectrum and outlook for controlling noxious plants.

Old concepts and attitudes must change. Councils can no longer afford to view noxious plants purely as an internal shire matter. To obtain positive control, noxious plants must be considered on a national, state or particularly at your level, as a watershed or common area problem.

The wide variation of attitude and approach which occurs from Council to Council must be overcome - uniformity and a common standard across the state must become a common objective.

The indiscriminate use of herbicides and neglect of operator safety must be prevented. The requirements of the Hazardous Pesticides Regulations under the Public Health Act, the Pesticides Act, and other environmental considerations must be observed.

Total reliance on herbicides to control noxious plants year in year out is a costly and wasteful exercise - it is also becoming environmentally unacceptable.

Local Government must look to the incorporation of new and alternative techniques to complement their spraying programmes - and the principles of land management must be embraced and should be included in all noxious plant control activities.

Your conference theme, "Noxious Plants - The Future Challenges and Trends", creates the climate for each of us to be responsive to the challenges and the redirection required to give New South Wales the modern, progressive statewide noxious plant control organisation necessary.

Since your first Biennial Noxious Plants Conference at Wagga in July, 1981, the changes to the rural community through drought and recession have been dramatic.

The effects of these problems have bitten deeply into the resources of both the public and private sectors. The need for survival has taken precedence over all other considerations and this unfortunately includes noxious plant control.

When viewed in this particular climate, it becomes most urgent that new techniques be developed to include land management strategies so that recurring costs can be curtailed.

Regardless of the prevailing circumstances, the New South Wales Department of Agriculture has always been aware of the need to control weeds. Despite current limitations on resources, ongoing research and advisory programmes on the study of weeds and their control are being given priority.

In particular, programmes are continuing for Serrated Tussock, African Love Grass, Alligator Weed and Parthenium Weed.

Advisory programmes continue to be developed from the Department's research into Serrated Tussock. The most recent of these is the SWAT Campaign, "The Statewide Attack on Tussock", being conducted in the South Eastern and Illawarra Region.

Recently, due to the prevailing dry conditions, African Love Grass has developed as a major problem, particularly on the South Coast and major research is being undertaken to develop cost effective measures to combat this problem. I am confident that it will not be long before this information is available.

The problem of Alligator Weed will take longer to overcome. Current work indicates that we do not have the herbicides needed to give effective control. While control measures are being re-evaluated a containment programme is being pursued by the Department in conjunction with Local Government and the co-ordinating Committee against Alligator Weed in the Hunter Valley.

In 1977, when it became evident that it was possible for Parthenium Weed to be introduced accidentally into New South Wales from Queensland, prompt action was taken by the Department. To combat its introduction, Parthenium Weed was declared a noxious plant in 1978 and since that time the Department, in conjunction with Local Government authorities, has developed a statewide awareness to the risk of its introduction.

To date, all known scattered infestations are under control. The Department of Agriculture through media outlets and with the release of a Parthenium Weed Agfact, is undertaking a statewide awareness Campaign. This campaign is being co-ordinated through the New England area of Agriculture Region 2.

Recently, the Parthenium Weed Agfact was posted out to all producers in the northern areas of the state where establishment of the weed was most probable. Reports of real and possible sightings have already been received.

It is unfortunate that drought could make the introduction of Parthenium Weed into this state a reality. Because of the drought, all feed brought in from Queensland, particularly private purchases, should be treated as suspect for Parthenium Weed contamination.

It is currently costing the Queensland authorities, $340 000 annually to contain Parthenium Weed to the Central Highlands. Imagine the cost to New South Wales if it should become established here.

Because of the serious health and agronomic problems associated with Parthenium Weed, the Department of Agriculture is giving this problem urgent attention.

As Director-General of the Department of Agriculture, I would like to congratulate Dr Leon Smith and the Weeds Section of the Department for the continued good liaison with Local Government authorities and other organisations.

These authorities and organisations have an ongoing commitment to control noxious plants throughout New South Wales. The attendance of Departmental Officers at this conference is evidence of the Department's active participation in these matters.

The Department has the responsibility to provide direction, technical and management advice and recommendations for all weed control matters.

In conjunction with the Noxious Plants Advisory Committee, some initiatives have recently been undertaken. In particular, I am pleased to announce that the Department of Agriculture has appointed a Technical Officer to assist the Special Agronomist (Weeds), both of whom are located at Glen Innes.

These Officers will service the weed problems in the northern part of New South Wales.

Both of these Officers are here today to participate in discussions. Mr Max McMillan, Special Agronomist (Weeds) and Mr Neville Strachan, Technical Officer (Weeds).

Before long, I expect that an additional Field Officer (Weeds) will be appointed to exclusively service the North Coast Region. With this appointment my Department will then have five regionally based Field Officers (Weeds), to service the noxious plant control requirements of Local Government. With This appointment I expect will also come a change in title, from Field Officer (Weeds) to Noxious Plants Advisory Officer.

Other initiatives taken in recent times include the development of policy statements for Local Government authorities and a Noxious Plants Control Manual for Weeds Officers.

It is essential that each authority have a policy for the control of noxious plants. Once formulated, a policy statement provides the operating base for controlling noxious plants. Such a statement in conjunction with a long term management control programme is the only way to effectively and economically control noxious plants.

The introduction of a Noxious Plants Control Manual, recently distributed to organisations in draft form, is a major step forward in the training and development of Weeds Officers.

It is essential that a common standard of uniformity and operation be developed to overcome the wide variation in attitude and approach that currently exists amongst Weeds Officers in Local Government.

Having studied the conference programme I am particularly pleased with the activities planned. It is evident that it is the most extensive programme ever covered at a conference of this type.

It is essential that all Weeds Officers be exposed to up-to-date methods and technology for satisfactory weed control. This conference certainly fills most of these requirements.

Of particular interest to me is the introduction of the "Innovative Ideas Competition", for Weeds Officers. The abilities and importance of Weeds Officers are not fully or adequately recognised over the years they have helped develop sound weed control management and practices.

The "Innovative Ideas Competition" is a small but significant way of showing appreciation of their contributions, effort and industry. I believe some ten entries have been submitted for the competition this Conference.

It is also pleasing to note the active support and sponsorship given to the conference by commercial companies. Without such liaison and working relationships between groups, nothing can be achieved. I would like to thank them for their support and participation and in particular Roche-Maag, Dupont, Dow Australia Ltd., and Monsanto Australia Ltd.

Another important feautre of the programme is the number of Weeds Officers who are presenting papers during the conference, the sharing of knowledge based upon practical experience in overcoming particular problems is important and of value to everyone.

Your participation as session chairmen is integral to the efficient functioning of the conference: and I congratulate you upon your active participation in these activities.

May I also extend my appreciation and thanks to all participants involved in the conduct and presentaiton of the conference proceedings.

I would like to thank Derek Brown, Field Officer (Weeds), Tamworth who as conference convenor, together with members of the Conference Committee, put together this excellent conference format. The Department of Agriculture gratefully acknowledges the support of Local Government Weeds Officers and their parent organisations who have participated on the Conference Planning Committee, particularly the New England Tablelands County Council which is the host Council for this conference.

Finally, on behalf of the New South Wales Department of Agriculture I thank you for your attendance. I am sure that the liaisons, knowledge and information gained from your participation at this conference will be of practical benefit to you.

Mr Chairman, Ladies and Gentlemen, it gives me very great pleasure to declare the Second Biennial Noxious Plants Conference Officially Open.

Controlling Drug Plants under the Noxious Plants Act - The Problems

By Hugh J. Milvain,
Field Officer (Weeds),
Department of Agriculture.

In this address I will outline the problems that have confronted me during the last 9 years as a Field Officer (Weeds) in the control of prohibited plants.

The Problems

The first experience with the Cannabis species was in May 1974 when invited by officers of Griffith Shire to assist their Noxious Plants Inspector to obtain co-operation from two landholders in destroying a regenerated seedling crop of Cannabis.

Both areas were on horticultural properties and were of approximately one hectare in size and grown in close proximity to the permanent plantings of fruit trees.

Two different approaches had to be made to obtain the control desired; site 1 was of a light textured soil capable of being cultivated and site 2 was waterlogged making it difficult to work with a tractor and implements and also at both sites there was a language barrier which had to be overcome.

At site 1 the landholder was willing to co-operate by carrying out any recommendation that was made, but at site 2 it was difficult to obtain any co-operation without the threat of a notice being served and the Council doing the control work. This lack of co-operation was because of the language barrier.

Then in November 1975 a major problem developed when a 12.5 ha "crop" was found by the Police Drug Squad.

At this crop there was a difference of opinion between the Police and the local Shire Council as to who should destroy the crop. The Council disagreed with the Police and Department of Agriculture on who should destroy the crop.

The Council attitude, disregarding the fact of it being a noxious plant, was that as it was a drug plant it was up to the Police to carry out the destruction.

The Council would not accept that it had a moral obligation under the Local Government Act to carry out the work. That as the landowner/ occupier was possibly in custody, who would meet the cost of the operation, was the question asked by Council.

After many days of delay the destruction of the crop was commenced under the guidance of the Department of Agriculture with the Shire Council acting as contractors supplying the labour and equipment which couldn't be hired from other sources.

On completion of the destruction the full area was sprayed with a residual herbicide to prevent seedling regeneration.

The cost of the operation was met by Treasury and, because the Council would not accept responsiblity after the destruction by serving a permanent notice on the property. A special authority under Section 475 G was issued to enable inspections to be carried out.

In March 1977 a 10 hectare area was located in virgin bush and under spray irrigation by Police Drug Squad.

Again there was a reluctance of the Council to carry out the destruction of the crop but legal advice from the Department of Local Government to the Council was that it could and then forward the account to the owner and if he could not pay then forward the account to Treasury for payment.

Some three quarters of the crop had been harvested prior to the detection of the site. There were fully matured plants present awaiting harvest and a drying shed of plants ready for processing and on the harvested area a high population of seedlings.

The same procedures were used in both 1975 and 1977 crops; that was to use a single row forage harvester and trailer to eliminate the standing material followed by burning of the foraged plant matter which had received a covering of distillate. Then a broadcast cover of residual chemical was applied by boom spraying where possible and by hand gun where the boom could not be used.

At the 1975 crop site the residual chemicals gave full protection for several years against seedling germination over the whole area treated with exception of the area where the crop was burnt.

At the 1977 crop site the same procedures were used with the residual chemicals but the results were poor. It was thought that the poor results were due to several factors such as high organic matter in the soil, high levels of carbon present from where the timber was burnt when cleared, insufficient water applied and poor water quality.

Controlling Drug Plants Under the Noxious Plants Act

By Dallas Parsons,
District Agronomist,
Department of Agriculture.

Controlling Marihuana plantations under the Local Government (Noxious Plants) Act 1977 and the Poisons (Further Amendment) Act 1977 demonstrates well the complexities and co-operation required to contain drug plants in New South Wales.

Under the current legislation the Director General of Agriculture has responsibilities in plant destruction and regrowth prevention. This task is usually undertaken by the District Agronomist as an agent for the Director General.

In the field, the operation success depends on a harmonious working relationship between the Police, the Local Council or Pastures Protection Board and the Department of Agriculture.

But, caution from the outset. A corruption awareness should be retained because of the large amounts of easy money involved and the influence this has already had on society.

Procedure

Firstly, and foremostly, a warrant authorising the Director General to enter the premises, destroy the plants and control regrowth must be obtained.

Liaison between the District Agronomist and the Chief of the Division is maintained at all times. This liaison provides the District Agronomist with a cross check at all times.

The District Agronomist establishes contact with the Detective-In-Charge and maintains that contact despite how hectic the situation. Both the Detective and the District Agronomist have obligations in relation to the plantation for the legal proceedings.

Plant identification and security are the police responsibilities but a strong emphasis is on the agronomist to provide the facts that the plants are being cultivated.

The facts require detailed notation as it is often more than twelve months before the final court case.

Arranging Destruction

The plantation must be sized up and in consultation with the local Council or Pasture Protection Board, labour and plant must be made available for the destruction. If the labour or plant can't be obtained through the Council or Pasture Protection Board contract arrangements can be made outside those bodies. The agronomist has authority to take personnel onto the premises under the warrant. Personnel can be for destruction or expert purposes.

Accountability

The New South Wales Department of Agriculture has a special fund to finance the destruction of plants. All associated costs are paid from the fund on authorisation from the District Agronomist. Providing the proper records are maintained and the accounts submitted there should be no delay in payment to the bodies concerned.

Media

Reporters can create problems in obtaining information and the way they present this to the public. Any information, if any, that is presented to the media must be treated with caution.

Sociology

Often the people involved in growing Indian Hemp are respected citizens within the local community. Often this so called reputation is placed above those people involved in destroying the crop. In several instances this sociological problem has caused strained relationships within the community concerned. This can create hidden difficulty for all parties involved in the destruction.

Safety

A police officer should always accompany any workman with the Department of Agriculture's authority on the premises concerned. There have been nasty instances involving firearms on some plantations.

Destruction

Each destruction requires individual attention. Many complications arise. Problems associated with plant concealment in normal crops, seed areas, soil types, inaccessible places, effects on the workmen, plant regeneration etc., etc., are best portrayed pictorially.

Conclusion

Looking at two most important aspects one, the physical destruction and, two the legal ramifications, it is paramount that co-ordination and communication between the Police Department, the Local Council or Pastures Protection Board, and the New South Wales Department of Agriculture be at a high in this topic.

Drug Plants as Noxious Plants

By Don Armstrong,
Chief Weeds Officer,
Far North Coast County Council.

The drug plant Cannabis sativa, commonly known as Indian Hemp or marijuana has assumed considerable importance in the Far North Coast County District over the last decade. The influx of alternative life-style people to the area, coupled with steadily rising unemployment caused by this influx, has compounded the problem. The incidence of the plant increased during the 1970's, culminating in two large plantations being found early in 1977. These plantations, at Huonbrook in Byron Shire and Terragon in Tweed Shire had estimated street values at the time of $1,000,000 and $2,000,000 respectively, and were well laid out commercial enterprises, complete with permanent irrigation and drying-rooms.

This was the cause of considerable concern by Council staff, and also Council itself, as quite apart from the legal and moral aspects, the element of physical danger for Weeds Officers carrying out their duties also had to be considered. The final concensus of opinion was that as it was a problem which would not vanish of its own volition, and could not be ignored or avoided indefinitely, it should be met head-on, and the area made as unattractive as possible to people who wished to indulge in this enterprise.

With this in mind, the then Chief Weeds Officer of the Far North Coast County Council, Don Brackenreg, pioneered aerial inspections for drug plantations, and Council carried this operation itself in the initial stages. The aerial inspections proved quite effective in locating Indian Hemp plantations, and were also extremely helpful for general purpose inspections, particularly in some of the rougher areas. The Police Department has now assumed responsibility for drug detection flight, but Council Weeds Officers still co-operate by acting as observers, as they have the experience and local knowledge to apply to follow-up ground searches.

Following representations by police officers to Council, early in the program, a good working relationship has been established between the Police force and Council staff, although at present, due to manpower shortages, and economic restraints not as much effort can be channelled in this direction as could be desired.

The concept of aerial inspection by fixed wing aircraft in the type of terrain found over much of the Northern Rivers area has proved much more successful than was at first expected. It is not uncommon for an experienced observer to pick out an area as small as 2 m square, containing possibly only five or six plants. The size of the plants themselves assist in detection, as it is not uncommon for well tended plants to reach 3.5 m in height prior to harvest.

It would appear that the program has had the desired effect, as although commercial crops are still being found, the operations are fragmented, and where once it was common to find a crop of in excess of 500 plants, this is now a rarity, the average being less than half this figure. During February and March 1981 a fairly large scale operation was carried out using helicopters of the Police Air Arm. Council Weeds Officers were involved both as observers, and in the ground operation. The Statistics from this effort were 85 arrests and 7,500 plants. The relatively low number of plants was quite pleasing, for the reasons already mentioned. The quantity of material which would have been available from these plants was quite large, however, due to the size and quality achieved. Again Council inspectors had the added bonus of getting a better look at large sections of their areas than they had ever had before. The helicopter operation was well planned, and co-ordinated by the use of portable 2-way radios and 4-wheel-drive vehicles. It was so successful, that the local growers complained bitterly that it wasn't fair, and one of our inspectors likened it to "shooting ducks on the water". Over the years, some of the more enterprising growers have developed quite efficient systems of camouflage, which made detection from a fixed wing aircraft difficult, but which could not stand up to the closer scrutiny provided by the helicopter.

By general agreement, the involvement of Council staff in court cases is kept to a minimum by the police officers concerned, as this facet of the work can be very time consuming. In some situations, however, it is necessary for a Weeds Officer to appear as a prosecution witness, and I personally consider this to be good experience, as after all, court appearances can be an integral part of a Weeds Officer's work in carrying out his normal duties.

The situation as it presently exists, is that we still have Indian Hemp being grown, and will always have it to a certain degree, but unless there is a softening of attitude by the Government, it is unlikely that large scale commercial enterprises will be undertaken in our area. This is of course dependent on being able to keep a reasonable staff of inspectors in the field, and the continuation of the present good working relationship with the Police force.

Drug Plants as Noxious Plants

By Frank Hansen,
Detective Senior Constable,
Intelligence and Liaison Officer,
Drug Squad,
Criminal Investigation Branch,
New South Wales Police Force.

Introduction

It is my intention to address you on the controlling of noxious plants from a law enforcement aspect. To indicate to you the various drug plants involved in drug abuse and trafficking on a criminal level. To do so it will be necessary for me to acquaint you with criminal legislation operating within the State to control this type of activity. Further, I intend to discuss the procedures involved in the destruction of a substantial noxious plant crop, again from a Police point of view including the evidential side, which would assist in leading to a successful prosecution of the offenders involved. Finally I will give a resume of drug abuse within the community and outline the current trends and styles of drug taking generally.

Prohibited Plants

As a member of the Police Force and in particular a member of the Drug Squad at the Criminal Investigation Branch, it is directly encumbent upon me to assist in the prosecution of offenders involved in the cultivation of a particular group of noxious plants, or as they are referred to in the Poisons Act of 1966, 'prohibited plants'.

In this regard our duties involve the investigation of criminal activities associated with the growing of these particular plants. Specifically we are concerned with the investigation, detection of the crops and the people responsible for them, together with the proper collation of evidence that will lead to a successful prosecution. It is important to understand from the start that the prosecution of offenders is based on the criminal law system, and of a legislative instrument, the Poisons Act, referred to initially. It is that Act which among other things defines a 'prohibited plant' as follows:-

(a) Any growing plant of the genus cannabis or erythroxylon or of the species papaver somniferum or papaver orientale, also known as papaver bracteatum;

(b) Any growing plant of a description specified in a proclamation in force under subsection 3.

It can be seen that the definition covers firstly the cannabis plant, the indian hemp plant, the marihuana plant; secondly, the erythroxylon or cocas plant from which cocaine is derived, and then it refers to the various opium poppy plants which of course produce the first substance in the chain to the production of morphine thence to the production of heroin.

The illicit growing of the erythroxylon or opium poppy has never constituted a problem within this State or for that matter within this country. This is due not only to the geography and/or climate of the country, but also to the lack of local expertise to convert the extracts of the plant to a viable product for consumption by drug abusers. It

should be understood that large quantities of the plant need to be grown and in the case of the cocas plant the leaves have to be crushed and the juices extracted from the foliage and then converted into a paste. From this a further process is required to produce the illicit cocaine for street consumption.

The cocas plant grows ideally in the altitudes and climate typical of Columbia, South America. This area produces all the illicit cocaine for world consumption, but I believe the country nearest to Australia with similar climatic conditions is Indonesia which once produced the drug commercially when it was widely used as a legitimate topical anaesthetic.

Likewise, the poppy needs to be bled of the raw opium prior to a complicated chemical process leading to base morphine and then further to heroin. This is just impractical when one considers the labour content and risks compared to smuggling the end product into the country for direct distribution. The opium poppy is grown under licence in a controlled situation for legitimate purposes in Tasmania and nowhere in Australia is the erythroxylon cultivated for any legitimate purpose.

It is obvious that the cannabis plant is the one that has constituted the major problem for law enforcement agencies within this country. In this State in particular we have, with very few exceptions, an ideal climate in all areas for the growing of cannabis; whereas I pointed out difficulties associated with the production of cocaine and heroin, none of these are present in the production of marihuana leaf for street consumption. Virtually the process involves growing the plant, stripping the leaves and allowing them to dry in a cool, sheltered environment and then selling it. It really could not be more simple. Once the seedlings have successfully got under way little attention need be given until it is decided to harvest the crop.

Policing the Cultivation of Cannabis

During the 1960's there was a sudden world wide drug culture explosion, which rested generally on indian hemp consumption. Australia felt the impact on the community and the increase in prevalence of this drug in society naturally led to the criminal element being involved in its production and distribution. Police resources were not accustomed to this new form of criminal activity and were somewhat overwhelmed by it. Significant plantations were detected flourishing blatantly in areas normally associated with legitimate grain and orchard production, and they ranged in size from a small acreage up to thirty acres of concentrated cultivation. In due course Police became attuned to dealing with this activity, but it should be noted that it was not until 1977 that present legislation was invoked which specifically dealt with the cultivation of these prohibited plants. At the same time the legislation covered the cocas and opium poppy plants. Prior to this Police relied on other sections of the Act in dealing with the possession of indian hemp.

The Poisons Act states any person who

a) cultivated any prohibited plant;

b) supplied any prohibited plant;

c) had in his possession any prohibited plant;

d) being the occupier, owner or leasee of any premises, permits those premises to be used for the purpose of cultivation or supply of any prohibited plant; or

e) is concerned in the management of any premises referred to in paragraph d)

shall be guilty of an offence under this division.

A conviction for an offence under this section carries a maximum penalty of a fine not exceeding $200,000.00 or to imprisonment for a term not exceeding ten (10) years, or both such fine and imprisonment.

To fully comprehend the offence, the definition of cultivate should be read in conjunction with this particular section. Cultivate includes grow, sow or scatter the seeds produced by; plant, nurture, tend or harvest a prohibited plant.

The result of this more effective policing was a significant reduction in large style plantations to the point where today they are non existent. In conjunction with this more rigid policing we also had the introduction of the Landsat satellite with its detection capabilities and the greater use of Police in aerial surveillance which played a major role in the control of these larger more spacious plantations. In this regard the offenders are unsure of the detection capabilities of the Landsat satellite in particular. It is evident that they are cultivating much smaller, better quality crops with a potential perhaps to greater yield from each plant, and not only a greater yield but a better quality drug as a result. This selective breeding goes even to the extent of removing the male plants and concentrating primarily on the female plants in a particular crop. The extensive use of camouflage in, and around these plantations would tend to support this theory. Not only are the shelters and extensive irrigation systems camouflaged, but the crops tend to planted in amongst a more dense and luxurious bushland in an effort to avoid aerial detection.

Irrigation is a necessity, especially if the plants are in the seedling stage and up to approximately two to three feet in height, and greater lengths are gone to, to provide adequate water to these crops. Recently a bush style plantation involved a four inch irrigation pipe from the water source to the plantation approximately two and a half kilometres away. Included in that plantation was a powerful irrigation pump and other sophisticated irrigation equipment. Because the offenders are unaware of the exact capabilities of either of these surveillance techniques, they are tending to be far more careful and even over cautious in their approach to the plantations.

It is believed that as a result of this more rigid policing, and particularly in the last two to three years, we have certainly seen a reduction in the quantity of indian hemp leaf available at street levels. As a guideline, about twelve months ago the cost per pound of indian hemp leaf was about $500.00 at wholesale level. It had remained that price for a number of years. Recently the average cost of leaf increased from this figure to eight or nine hundred dollars per pound, and this fluctuating of prices is a real guideline to availability. It is also interesting to note that appearing on the market place is not only the ordinary leaf available at the prices mentioned, but the introduction of the flowering head of the female plant. It is a better part of the plant, that is a better quality form of indian hemp, for the same quantity that is on a poundbasis. The heads are selling for around $1,300.00 and this of course supports the theory expressed earlier about the selective, better quality crop as opposed to the average mass produced leaf. In this State the indian hemp plant is sown around October/November of each year and depending on proper care and climatic conditions associated with the individual plant, it would be expected that in ten or fifteen weeks from that time the plant would be approximately six feet tall. It has similar growing characteristics to a tomato plant. It is at this size that the plant becomes a marketable product, in other words, it is mature enough to be harvested and produce the desired effect when smoked. It is generally estimated that a healthy six foot plant will yield approximately one pound of indian hemp. It should be borne in mind that the plant, if grown in ideal situations in one complete season, will reach a maximum height of approximately fifteen feet. It should also be borne in mind that after the plant has left the seedling stage and has grown to around two feet in height, it can generally survive quite well on its own with adequate water without any formal attention.

As the indian hemp plant is a summer crop, it is reasonable to assume that availability fluctuates on a seasonal basis. This of course is correct, but there are positive indications, putting this factor aside, that the imported version of the drug is more prevalent now than

in the past. Further, instead of it being seen basically consumed during spring and summer, prior to the domestic harvesting, it is apparent throughout the year. By this form I mean block hashish and to a far lesser extent, hash oil. These are the stronger, more toxic forms of the drug and are manufactured by removing the resin from the leaves, generally by beating them with leather on leather. The resins adhere to the leather and when scraped from it are treated, and compressed, to form block hashish, and undergo further processes to produce the extremely concentrated hash oil. These forms of the drug are significantly more expensive, but preferred by the regular marihuana consumer. As an indication, block hashish would wholesale for approximately $3,000.00 per pound and the oil would be open to negotiation depending on its scarcity. It would generally be nearly double the price of the hashish. It is felt that the increasing prevalence of hashish in particular, indicates the traffickers are moving away from the more risky plantations to a more secure venture in importation. Block hashish and oil are not manufactured here for the same reasons outlined in respect to cocaine and heroin.

Destruction of a Cannabis Plantation and Securing Evidence for the Prosecution Case

For a successful prosecution under the Poisons Act is is not only necessary for the Police to prove beyond a reasonable doubt who was responsible for the plantation, that is, identify the offenders, but to prove firstly that the plant was 'cultivated' under the definition as related to you, and that it was a 'prohibited plant', again relying on the respective definition. In small backyard plantations and potted individual plants, the Police rely on their observations in relation to the cultivation aspect, that is, that it was a growing plant, tended and watered. To prove that it was a 'prohibited plant', the entire exhibit is conveyed to the botanist at the Royal Botanical Gardens for examination. The botanist ultimately produces a certificate under the Poisons Act indicating that the plant falls within the definition of a 'prohibited plant' and nominates it.

Today, however, I intend to go into far greater detail in relation to significant and large plantations, and it is in this aspect that the services of the Agricultural Department play a significant role.

So, firstly we will start with the proposition that a member of the Police Force has received reliable information from a responsible source known to him, that a prohibited plant, and we will say for argument sake, indian hemp, is being grown on a particular property, or on a particular premises. This Police Officer then appears before a Justice of the Peace and upon oath seeks to obtain a Poisons Act search warrant. If that particular Justice of the Peace sees fit, a search warrant will be duly issued in respect of those premises. This search warrant gives the power to any member of the Police Force to enter the premises or property nominated, search it, and to search any persons therein. It remains in force for one calendar month. A Police Officer on executing that warrant can use whatever force deemed necessary and there is a significant penalty for any person who willfully hinders or delays a Police Officer whilst executing that warrant.

So we can assume that the search warrant has been executed, a plantation of indian hemp has been located, and offenders have been arrested; and in this particular case that it is physically impossible to remove it all to a place of safety and have it detained in that place, say a Police Station, until the completion of the court matter. In other words, it is physically impossible to do so. It is therefore obvious that the plantation has to be destroyed.

In this, like all other criminal prosecutions, there are the necessary proofs to be sustained for a successful prosecution. To do this, it is the normal procedure for a member of the Police Scientific Investigation Section to attend. It is in his duty to record important aspects; the photographic evidence in relation to the site; to take into possession evidence for the prosecution case; and it includes the labelling and collation of exhibits. Now we can assume again at this

stage that that aspect has been completed; it is now our job to destroy that particular plantation. In this regard a Police Officer will then appear before a Stipendiary Magistrate, inform that Magistrate on oath that he believes a 'prohibited plant' is being cultivated on a particular property. A Police Officer on this particular occasion is seeking a warrant, again under the Poisons Act, and interestingly enough, one which is directed to the Director General of Agriculture, and any person authorised by him, in other words the local agronomist. I shall read to you the format of the information to obtain a warrant in this particular section:-

> *BE IT REMEMBERED THAT Frank Robert Hansen (hereinafter called the informant), a Detective Senior Constable of Police of the Drug Squad, Criminal Investigation Branch, in the said State, appears before me, the undersigned, a Stipendiary Magistrate in and for the said State and on oath informs me that he the said informant suspects (or believes) that prohibited plants, to wit, indian hemp, are on premises situate at the address nominated in the said State, and grounds his reasons as follows:-*

Now these reasons would vary of course from one particular inquiry to another, but generally it would be in fact, that an experienced Police Officer has made an inspection of a particular area and further has carried out inquiries which have led him to believe that a particular prohibited plant is being cultivated on the premises. And reading on:-

> *and the informant prays that I, the said Stipendiary Magistrate will proceed in the premises according to law and issue my Warrant directed to the Director-General of Agriculture and any person authorised by the said Director-General, under the provisions and for the purposes of Section 33B of the Poisons Act, No. 31 of 1966, as amended.*

If the Magistrate feels on the information that has been given to him on oath, that a warrant should be issued in accordance with the Act, he does so. I will now read the warrant which as I said before was directed to the Director General of Agriculture and any person authorised by him. It reads:-

> *WHEREAS Frank Robert Hansen (hereinafter called the informant), a Detective Senior Constable of Police of the Drug Squad Criminal Investigation Branch in the said State appeared before me, the undersigned, one of Her Majesty's Stipendiary Magistrates in and for the said State, and upon oath informed me that he, the said informant, suspects (or believes) that certain prohibited plants, to wit, indian hemp, are on premises situate at the address nominated in the said State.*
>
> *Reasonable grounds having been shown by such informant for so suspecting (or believing), I, the undersigned, Stipendiary Magistrate grant a Warrant authorising the Director-General himself, or any person authorised by him, to enter the said premises and take such steps as he thinks necessary for the purpose of destroying the said prohibited plants on the said premises and preventing any regrowth of those plants and subsequently from time to time to again enter the said premises and to take steps for those purposes until he is satisfied that the said prohibited plants have been completely destroyed and their regrowth effectively prevented, and for so doing this shall be your Warrant.*
>
> *It is then given under his seal and dated.*

The warrant has been obtained so the Police Officer then contacts the local agronomist. The warrant is presented to him and it is then his obligation to go to the premises named and destroy the particular

crop. Until the arrival of the agronomist the cultivated site remains untouched.

Upon his arrival it is then expected that he would work in close liaison with the Police Scientific Officer. In that capacity he can obtain random samples as he sees fit, collate the information as to the size, nature and extent of the plantation. He may even be in the position to comment on the extent and effectiveness of any irrigation systems located on the premises. As the random samples are being obtained the Scientific Police Officer would assist him in photographing the samples and recording the location from whence that sample was obtained and labelling that sample accordingly. The agronomist together with this Police Officer would then package and label the samples obtained in the best possible manner so as not to disturb them, or disturb their leaf structure, and to preserve the plant in the best practical way. They are then forwarded to the Botanist for examination and identification.

In a subsequent statement to the Police it would be envisaged that not only would the agronomist indicate the nature of these duties that he performed, but also attempt to give some indication to the overall size, specifically, an estimate of the number of plants being grown and again an estimation of the total yield of that particular plantation. It is the primary task of the agronomist to prove the definition of cultivation under the Act to satisfy a court of the first proof, that is, the fact that the plants were being cultivated under the definition in the Act. All these duties of course is a significant role played by the local agronomist. He is of course providing independent expertise so important in a successful Police prosecution.

So it is assumed that the samples have been obtained and it is also assumed no further use, from an evidentiary point of view, can be made of the crop. It is then, as the warrant indicated, the role of the particular agronomist to destroy that plantation; and he does so by using whatever means he sees fit. It more often than not includes the services

of the local Shire Council. It is of course they that can provide the necessary equipment to assist in the ultimate destruction of the plantation.

Under the relevant local Government Act is the requirement of the Shire Council to notify the Officer in Charge of the Police Station nearest the site of the crop at least twenty-four hours before the intended time of destruction that the Council or Shire intends to carry out the destruction procedures.

The cost of the operation is borne by the Agricultural Department and at a subsequent court hearing an application can be made by that Department for reimbursement from the offender or offenders as the case may be.

So it is now assumed that the plantation has been destroyed on the site. Going back to the warrant, the wording of that indicates that at any time in the future an agronomist, or the Director General of Agriculture specifically, can enter the said premises and take steps for the purposes of the preventing of any regrowth of those plants. There is no time limit placed on that particular aspect, so it would be envisaged that in five to ten years time the local agronomist, whoever he may be, may, using that original warrant, re-enter those premises to ensure there has been no regrowth of the particular prohibited plant.

Following the successful destruction of the plantation, the samples that had been obtained by the Police in conjunction with the agronomist are then transported in the normal course as a Police exhibit, to the Botanist in Sydney, who will then examine the plants and issue a certificate previously referred to, and in doing so he will indicate if it is a prohibited plant under the Act. The major portion of the Police evidence in relation to the plants themselves, and the fact that they were being cultivated has been satisfied. In any of these prosecutions it is primarily a question as to who was responsible for the particular crop which is the subject of conjecture.

Drug Abuse Within the Community

Drug addiction and drug abuse generally is, without doubt, a major problem within our community. The problem is not confined to Police, Government or health authorities, nor is it for that matter limited to the abusers/addicts themselves. It is a social problem, the impact of which is felt by every member of the community.

Heroin is the nucleus around which various anti-social and criminal activities revolve. When one considers that an addict with a 'normal' habit can need an intake of one gram of the drug a day, and that quantity on Sydney streets costs about $350.00, one can understand the desperate measures taken by these people to satisfy the most demanding physical craving. The addict in need of money is responsible for the dramatic increase of house robberies, assault and robberies in the street, armed hold-ups and other crimes committed to fund the addiction. It has been established that 70 to 80 percent of armed hold-ups are carried out by addicts for this purpose. Associated with the necessity for funds is male and female prostitution, which although not criminal in the true sense, is a social problem which should not be overlooked. We can also include in this bracket an upsurge of criminal activity revolving around the importation and distribution of the drug. There are enormous financial gains to be made in this area but also an aspect of violence within that element, often leading to murder, where there has been a falling out between members. Obvious direct costs borne by the community include the provision of law enforcement agencies, health and welfare agencies, and the fact that the addict is an unproductive member of the community.

Heroin is the drug which has the greatest impact and which creates all these problems outlined; but other drugs should not be overlooked or neglected even though a number of them are portrayed as 'recreational' drugs by people promoting general acceptance of them. In this regard I refer to cocaine and marihuana, in particular the latter.

Firstly I intend to discuss cocaine. I am predicting that during the next ten years there will be a steady but marked increase in its usage throughout the general community. It is a drug which is introduced to the user initially at a social level with the pretence of being a 'glamorous', high status stimulant. Its euphoric high, the associated feeling of well being and artificial self confidence makes this initially an attractive drug. The insidious dependence forming nature of this drug makes it one to be reckoned with. The emotional dependency created by cocaine takes this drug immediately out of its social recreational use into the classification of a dangerous drug. Again not only to the abuser but the community for most of the reasons outlined when I referred to heroin.

Cocaine in the United States of America is proving to be as great a problem as heroin and certainly, within the last fifteen years, spreading so rapidly in its usage so as to touch a more diverse section of the community than heroin.

Marihuana would be the most used and experimented with drug in our community and it is also the most controversial and contentious. It is a stupefying drug which, although studies into its effects, detrimental or otherwise, are still being pursued, are very much inconclusive. The dependency formed and the proportional amount used by the individual varies significantly from one person to another. It is obvious that some people are in a better position to handle various drugs, including alcohol, than others, and this should always be clearly borne in mind. The ramifications of uncontrolled usage of marihuana within the workplace as well as within the recognized social structure should not be underestimated.

There are various other lesser known and even exotic mind altering drugs available within the community, all of which are dangerous and open to abuse.

As drugs and drug usage is relatively new on the Australian scene, a number of us here would not have grown up with them around us. For this

reason most of us are not in a position to discuss them and their effects proficiently. This certainly places us in an awkward position when confronted in a discussion about drugs with younger members of the community. Basically my point is that drug taking is now part of our society, and as members of the society we cannot overlook it. We should endeavour to make ourselves conversant with various drugs and their effects before accepting a theory put to us, from whatever source.

It should also be borne in mind that the drug abuser does not come from a predetermined section of the community. Their backgrounds are as diverse as one can imagine. The only common denominator is the fact that as individuals, they have sought a drug to satisfy a deep emotional need. If one can confront an individual problem on this basis there is a real chance of recovery.

Legal Problems at the Workface

By Bob Leach,
Agriculture and Noxious Plants Controller,
Snowy River Shire Council,
Berridale.

This paper is designed to offer information for potential legal action on behalf of Local Government bodies in the interests of noxious plant control. Only a minority of Councils in the state of New South Wales have resorted to legal action for the purpose of weed control with a reasonable degree of success. The reasons for lack of success are many and varied and in some cases the odd failure has prevented continuance by some Councils along these lines.

I am firmly convinced through my own and many other Weed Officers' experience that a small minority of landholders in every area deserve and need prosecution, if successful noxious plant control is to be practised. To hope for, and expect 100% co-operation, is putting one's head in the sand. I feel every Council who is vested with weed control responsibilities must operate from a firm base. To do this they must first exercise their powers under the Act successfully before relying upon good public relations and amiable co-operation from ratepayers. This latter method may work after the firm base has been established but not before.

It is intended for the purposes of this paper, to offer constructive procedures necessary for any successful court action. In addition, further information is included which is a result of contact with other Councils who have experienced legal problems in pursuing prosecutions under the Act. These are included to promote discussion and clarification by members of the legal profession who will be in attendance.

The use of the noxious plants section of the Local Government Act, and for that matter all Acts of parliament, requires a clear cut format to eventually lead up to successful prosecution and recovering of associated costs or both. These are likened to building blocks, where each stage must be properly executed before attempting the next step. Local Government

bodies by and large have had mixed success with noxious weeds prosecutions and many failures can be attributed to lack of knowledge of the necessary procedures.

Procedures

1. *The Governor by proclamation declares a plant to be noxious pursuant to Section 467 (1).*

2. *Council gives notice of the proclamation in the newspaper pursuant to Section 472 (1).*

3. *The Noxious Plants Inspector, inspects private lands suspected of having noxious weeds on them and satisfies himself that the plants are in fact noxious plants.*

4. *The Noxious Plants Inspector or Weeds Officer, makes a written and/or verbal report to the Agricultural and Noxious Plants Committee, or whichever Committee handles this aspect of business.*

5. *The Committee makes a recommendation to Council to serve the owner or occupier of infested land with a notice under Section 473 (2).*

6. *Council resolves to adopt the recommendation of the Agricultural Noxious Plants Committee Meeting.*

7. *Section 473 (2) Notice is served on owner or occupier of infested land.*

8. *The Noxious Plants Inspector, giving a time limit for control, inspects infested lands to determine whether Section 473 notice has been complied with.*

9. *The Noxious Plants Inspector reports to the Agricultural Noxious Plants Committee.*

10. *The Committee makes recommendation to Council that a notice pursuant to Section 474 be given to the owner or occupier who has failed to comply with Section 473 notice or otherwise prosecute under 473.*

11. *Council resolves to adopt recommendation of Committee.*

12. *If 474 entry decided upon Council resolves to instruct its servant or agents to enter upon the land and take whatever measures are necessary to eradicate the noxious plants and also resolve to forward a notice of entry on the owner or occupier.*

13. *Section 474 (1) Notice is served on owner or occupier.*

14. *Council's servants attend to eradication of noxious plants.*

15. *Council to make written demand on the owner or occupier for any costs and expenses reasonably incurred by the Council in eradicating the noxious plants.*

16. *If the owner or occupier fails to respond to demand then that failure should be reported to Council.*

17. *Council resolves to take legal proceedings to recover the costs and expenses as a debt in any court of competent jurisdiction.*

18. *Council resolves the control action on 473 notices or delegates this function to a responsible officer.*

Comments

1 - 4 *The first four steps are straightforward and need no comment.*

5. *Before making a recommendation the Committee must be satisfied that:*

(a) *The plants are noxious.*

(b) *They are growing in private lands occupied or owned by the person to whom the notice is to be sent.*

(c) *That the occupier is not taking reasonable and effective measures to eradicate the noxious plants.*

While an occupier of land may take some action to eradicate noxious plants which may be described as reasonable, Council is still in a position to give notice provided the action taken by the occupier is not effective. Effective measures in our view means action which in fact eradicates the noxious plants.

6. *Provided the recommendation made to Council by the committee is expressed sufficiently clearly, such that, if adopted by Council it will form a resolution of Council. If the adopted recommendation does not specifically authorise a notice under Section 473 to be given to the owner-occupier it may be ineffective.*

7. *While it is not essential that Councils use Form 2 (Ordinance 50) it is recommended that they do. Perhaps the most important requirement of the notice is that it describes the particular parts of the land from which Council requires the noxious plants to be eradicated. The Council may describe the land in the notice or indicate the land affected in a sketch accompanying the notice. If the description is wrong then the notice may be held to be ineffective when attempting to recover costs and expenses incurred in eradicating the noxious plants. Councils may specify in the notice which of the prescribed means, measures, methods, or acts which the owner or occupier is to take in eradicating the noxious plants. If there are no prescribed means, measures, methods, or acts then Council can require the owner or occupier to take any measure it considers necessary to enable the plants to be eradicated.*

8. *At the expiration of the period given in the Section 473 Notice the Noxious Plants Inspector should make a physical inspection of the property to ascertain whether any eradication programme has been commenced.*

9. *No comment necessary.*

10 - 12 *Same comments apply as in 5 - 6 above.*

13. *The notice under Section 474 (1) should be given in accordance with form 3 Ordinance 50. Once again it is important that the property to which the notice relates be properly described. The description on this notice should be identical with the description in the Section 473 notice and once again may be given by indicating the particular parts of the land affected in the sketch accompanying the notice.*

This notice may be served on the owner or occupier in any one of the following ways:

(a) personally,

(b) by delivering it to the premises where the owner or occupier lives, carries on business and leaving the notice with any person apparently above the age of 14 years resident or employed at those premises, or

(c) by posting the notice by pre-paid letter addressed to the last known place of abode or business of the person to be served.

This method of service also applies to service of the Section 473 Notice.

14. *After the notice pursuant to Section 474 has been served on the owner or occupier then Council may forthwith enter upon the land and take whatever measures are necessary to eradicate the noxious plants as seems right and proper to the Council in the circumstances. Council is therefore given a wide discretion to take whatever steps it considers right, proper and necessary to eradicate the noxious plants. If independent contractors are to be involved then the Weeds Officer or an authorised servant of the Council should supervise the eradication programme.*

15. *Section 474 (2) provides that any costs and expenses reasonably incurred by the Council can be recovered from the owner or occupier by the Council. In our view reasonable costs and expenses would include any costs and expenses which Council found necessary to incur in organising and completing the eradication including all material costs, costs of running any vehicles including Council owned vehicles, aerial costs, contractor's fees, wages for any casual staff employed for the purpose of eradication and a portion of the wages of any permanent Council employees which are assigned to the eradication programme. A portion of the salary of any salaried officer of the Council would not be recoverable.*

16. *At the completion of the eradication programme the costs and expenses incurred should be ascertained and a letter of demand sent to the owner occupier demanding payment of the costs and expenses and refer to Section 474 (2) of the Act.*

17. *If the owner or occupier fails to respond to the letter of demand the Council should resolve to take legal proceedings for recovery of the costs and expenses and the matter should then be placed in the hands of the Council's solicitors for legal proceedings.*

18. *Council must either clearly define the control means to be effected on 473 notices by resolution or alternatively a responsible Council Officer given delegated authority to prescribe such control.*

Aspects for Discussion:

These can be split into (A) Factual information collected from Councils around the State and proven in Court. However some discussion from Legal Officers are needed.

(B) Pertinent aspects and problems requiring further clarification.

(A) *Factual information collected from Weeds Officers Statewide resultant from contested court action:*

1. *473 and 474 notices must have accurate information as to the areas to be controlled, i.e., correct Parish, Portions and or Deposited Plan numbers, etc., and the 2 notices must agree.*
2. *Any account for control work effected under 474 entry should not contain reference to a specific area as it then becomes necessary for the Council to prove. All it is necessary to prove are that the expenses were reasonably incurred.*
3. *Constant updating of Council's land ownership records are necessary. If any doubt exists a Registrar General's title search may be required.*

4. *Council requires to Delegate the authority to prescribe the control measures on Form 2 Ordinance 50 or the 473 notice, to a responsible officer. This gives much more flexibility in compiling the notices, provided that the wording to be used has been checked out legally first.*
5. *Close contact and thorough briefing is necessary between weeds officer and prosecuting solicitor. All aspects of each case need explanation and documentation.*
6. *A history of previous control measures on a property and past co-operation in control efforts should be provided also for case preparations.*
7. *Description of control efforts on neighbouring properties.*
8. *Some Councils have had a good success rate from issuing Solicitors letters threatening prosecution. This can only work where the Council concerned has a firmly established and successful history of prosecution.*
9. *A system of inspection report forms prior to issue of 473 notices (preferably in duplicate book form), with all pertinent information including a deadline and posted or personally delivered, offers considerable assistance in resultant court action.*
10. *All conversations and correspondence including telephone calls should be recorded in a diary as date and relevant details of conversations are valuable evidence.*
11. *An accurate recording and filing system is of utmost importance when legal action is being considered.*
12. *Allowance of a reasonable time period for control to be effective is very important. This can vary considerably dependent upon the weed problem.*
13. *All costs associated with 474 entry must be reasonably incurred. One Council's Solicitor argued that this does not mean weeds officers' time on administrative and inspection duties.*

14. *For Councils embarking on legal recourse for the first time it is important they have good reliable legal aid. To be fobbed off with junior partners should not be tolerated. It may mean involving solicitors from out of town. However this extra expense is worth it until Council expertise develops. Once weed staff are confident there is less reliance on solicitors.*

15. *The matter of registration of a chemical used in control measures after entry under 474 may be a point contested in court action for debt recovery. This is a point worth clarifying prior to use of a chemical.*

16. *Where strong letters are used threatening legal action it is necessary to post these by "A.R. certified mail". Here again Council must have an established successful legal basis to work from. This method is cheaper than (No. 8) where the Solicitor forwards them. These letters can become a preliminary lead up to prosecution under section 472 (2) of the Act if specific reference to this section is inserted in the letter.*

17. *It is of assistance in court action if an invitation to contact the Council's weeds officer and discuss the problem be put on inspection report notices and are subsequently unheeded.*

18. *It is necessary to identify the status of the addressee in the case of a summons under 473 or 474 of the Act, i.e., whether he is owner or occupier.*

19. *If a weeds officer is asked to answer a question yes or no in court when giving evidence, he has the right to appeal to the Magistrate that he cannot answer yes or no but requires to give an explanation.*

20. *If time is required to think, under cross examination when giving evidence in court, ask the Solicitor to repeat the question.*

21. *Do not attempt to identify a plant in court if there is any doubt, i.e., if the plant has deteriorated or is under stress.*

(B) *Pertinent aspects and problems requiring further clarification:*

1. *Service of summonses can become a problem if it is served in the wrong manner, e.g., companies require a director and a business address?*

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2. *Some Councils utilise Section 472 (3) successfully and there appears to be less preparation, a letter and/or an inspection report from Council intimating prosecution appears all that is necessary.*

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3. *Often photographic evidence in court can assist a case, specially where 474 entry has occurred and debt recovery is necessary.*

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4. *In some court action it can be of assistance if the weeds officer concerned with prosecution evidence can be classified as an expert witness. It may be necessary in such cases that a chief weeds officer handle the case and be the informant if subordinate officers have not sufficient experience and qualifications.*

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5. *Clarification is necessary as to what is a criminal and civil action. Debt recovery under 474 entry is classified civil, 473 action is criminal, what is 472? Some Magistrates appear to regard civil cases more lightly.*

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6. *Numerous Councils around the State have had adverse course experience from the use of a sketch accompanying 473 notices. It appears in every case that the sketch is and can be taken by a defendant to be a precise compilation of the situation. If the sketch diverts in the slightest way from the exact situation, it can be used against the Council. It is impossible apart from a complete survey by a qualified surveyor to accurately construct a suitable sketch.*

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7. *Fines and costs awarded to Councils in court seldom cover the legal costs associated with prosecution. This has a deterrent effect from Councils not to proceed with legal processes.*

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8. *There appears a general need for standard property inspection report forms, posted from Council's office or handed personally to owner or occupier and noted in a diary. These forms should have sufficient information to form a basis for prosecution.*

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9. *Conflict does exist whether 473 or 474 notices should apply to the whole property or to Parish Portions.*

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10. *Companies owning land may require a search through the Registrar General's Office for title and the Corporate Affairs Commission for other details.*

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11. *Companies may also require registered posting of notices, letters and inspection reports, etc., to a manager or secretary at Registered address.*

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12. *Difficult cases to handle are where recalcitrant landowners do some work, promise more in writing or verbally and do not meet their commitment. Some discussion is necessary to identify what is a sufficient control programme.*

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13. *In some potentially difficult cases it may be advisable to have two weeds officers to inspect an area, especially so if court action is planned.*

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14. *If a Council finds it necessary to plot the size of an area after entry under 474 to determine measurement of the control effected, if contested, there are methods available either through a surveyor or using 1 mm graph paper and large scale aerial photographs or large scale maps to relatively accurately assess this.*

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15. *It is advisable where applicable to have a final inspection just prior to a court case and if necessary take polaroid photographs and/or other pertinent notes as to the state of such control programme.*

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Pesticides and Environmental Protection

By John C. Chapman,
Scientific Officer,
Chemicals and Wastes Branch,
State Pollution Control Commission.

1. *Environmental Problems with Pesticides*

Only thirty years ago herbicides constituted a small proportion of the total world market for crop protection chemicals, but by 1980 this share had risen to 42% of an $11,600 million market (Farm Chemicals, September, 1981), of which Australia shared about 1% (Miller, 1979). This share is gradually increasing.

It is commonly recognised that herbicides confer considerable economic and environmental benefits. The economic benefits derive from their use in crop and pasture production and maintenance of rights of way and waterways. The environmental benefits include those derived from reduced tillage in agriculture, such as less damage to soil structure, reduced soil erosion and a saving of fuel (Hileman, 1982).

Over the past decade, the adverse environmental effects of pesticides in general, of which herbicides are one sub-group, have become apparent. Experience from specific incidents has highlighted the greater potential for environmental damage and this has counterbalanced some of the benefits of these chemicals.

Environmental contamination by pesticides (apart from questions of operator safety) has resulted from one or more of the following:

- *Persistence, bioaccumulation and translocation of those pesticides (or metabolites) which are resistant to degradation by natural means. Such pesticides may not show acute toxicity in laboratory animal tests but can become widely dispersed in the environment and accumulate in animal tissue increasing the possibility of chronic effects. A number of organochlorine insectidices, such as DDT, fall*

into this category but some herbicides have a similar potential, e.g.,trifluralin, hexazinone and picloram.

- *Incidents involving spray drift onto non-target species, which have resulted in economic loss or, at least, generated ill-will between neighbours. Varying damage has occurred, including injury or death to desirable crops or to mature trees along rights of way, as a result of spraying of herbicides. Such incidents were highlighted in submissions to the Committee of Inquiry into the Use and Safety of 2,4,5-T and also occur with other herbicides. Some lines of dead roadside trees near Hay, New South Wales, in 1982 attest to the deleterious effects that herbicides can have, in this case Velpar, by movement through the soil.*

- *Transport accidents which have led to pollution of nearby waterways and adjacent soil. Environmental damage has been aggravated when unsatisfactory emergency clean-up procedures have been employed. Washing down of spillages, instead of damming and absorption onto soil or sand, has exacerbated the problem causing dispersal of the spilled concentrate through a large area of environment. Pollution of the estuarine section of the Lane Cove River about three years ago followed a transport accident and breakage of trifluralin drums. Discolouration of water and fish kills resulted. If, in the event of such accidents the Agricultural and Veterinary Chemicals Association (AVCA) code "Disposal of Pesticides Spills" is followed, dispersal of pesticides into the environment should be minimised.*

- *Unsatisfactory disposal of "empty" pesticide containers and waste pesticides including all contaminated materials resulting from transport accidents can result in contamination of soil, streams and groundwater over a long period of time.*

  This is a continuing problem. The SPCC, in conjunction with the N.S.W. Department of Agriculture, is compiling guidelines for disposal of containers, as discussed in Section 4 of this paper.

The occurrence in pesticides of trace impurities which are much more toxic and persistent than the parent pesticide can constitute an environmental hazard. The best known example of this is the dioxin impurity (TCDD) in 2,4,5-T. Much of the evidence indicates that 2,4,5-T itself does not present a major hazard towards humans and the environment, whereas TCDD is acutely toxic to test organisms and has caused severe injury to humans and animals following accidents at manufacturing plants. An extensive review of the environmental effects of 2,4,5-T in New South Wales (SPCC, 1981) has failed to find any problem of environmental contamination from 2,4,5-T formulations sold in the State. Nevertheless, in view of the high inherent toxicity of TCDD, the State Government has announced a tightening of the uses of 2,4,5-T and a reduction in the prescribed TCDD limit from 0.1 to 0.01 mg/kg of technical 2,4,5-T (December, 1982). This will ensure that there is no undue risk of teratogenic, mutagenic or carcinogenic effects in continued use of 2,4,5-T as currently approved in New South Wales.

2. *Evaluating and Predicting the Environmental Effects of Pesticides*

The potential for a chemical compound to contaminate the environment depends on a number of factors, the most important of which, according to Hutzinger et al (1978), are:

- *Amount of chemical released into the environment. This depends on human activities such as quantity and techniques of production, mode of transport, use and disposal and can be controlled to some extent by codes of practice or legislation.*
- *Environmental dynamics (ecokinetics). This depends on the dispersion behaviour, bioaccumulation, persistence and availability of sinks (i.e., areas of final accumulation).*
- *Biological effect (ecotoxicity). This depends on the mode of action of the chemical on organisms and on their ecological interaction within the environment.*

Awareness of the adverse effects of pesticides in the environment has led to increasingly sophisticated methods for anticipating the pollution potential of a new pesticide during its development stage.

An understanding of the parameters on which these factors depend provides a basis for assessment of the environmental acceptability of a new pesticide. Such an assessment should answer two questions (Gilbert, 1979):

- *What is the highest concentration of the chemical likely to be present in the environment?*
- *What is the lowest concentration which will cause adverse environmental effects?*

The OECD (1981) provides details of some of the prerequisite chemical information required for initial assessment of the behaviour of a chemical in the environment. This includes the following:

- *Water solubility and vapour pressure which give indications of the compartment (air, water, soil) into which the chemical moves.*
- *Absorption co-efficients which indicate the mobility of the herbicide in the soil, likelihood of groundwater contamination and uptake by plant roots.*
- *Chemical stability, including stability in sunlight (photodegradation), which will indicate the persistence of the herbicide under different environmental conditions.*

- *Partition co-efficient (n-octanol/water) which is particularly useful in predicting the potential distribution of chemicals in the aquatic environment according to fat content of individual organisms (Crosby, 1975, Ellgehausen et al, 1980) or the distribution in the different tissues of terrestial organisms.*

Although chemical properties can give some indications of the potential environmental behaviour of pesticides, data on the physical,

chemical and biological aspects of the receiving environment are also essential. The persistence of a chemical in each compartment (air, water, soil) is influenced by the properties of the respective compartment. Persistence or accumulation in air may not be significant, in contrast to water or soil, but air is important as a medium for longdistance transport of pollutants.

Individual chemical and physical data elements on the environment are relatively easy to obtain but the great complexity of ecosystems and constraints of knowledge and time necessitate the use of indirect measurements for biological assessment in receiving environments.

Apart from the damage that would be caused, field testing of pesticides and other synthetic chemicals is inappropriate because of the great variety of chemicals and the uncontrolled environmental conditions. Reliance is placed on ecotoxicological studies using laboratory organisms.

The Organisation for Economic Co-operation and Development (OECD) has promoted laboratory ecotoxicological tests which employ aquatic organisms - algae (growth inhibition tests), daphnia (acute and 14 day reproduction tests) and fish (acute toxicity tests) - to provide an initial assessment.

A second series of confirmatory tests, including chronic toxicity, specific routes of contamination, and different species or environmental compartments, could then be adapted to evaluate uncertainties raised by the initial tests.

In cases where appreciable environmental concentrations are anticipated or an environmental hazard is apparent it may be necessary to conduct a third series of tests with model ecosystems more nearly approaching the natural systems in order to clarigy the functioning of a multi-species system and inter-specific relationships.

The SPCC is currently assessing the extent to which ecotoxicological data obtained in Europe and America can be extrapolated to Australian conditions. We may find it necessary to develop similar tests based on Australian flora and fauna for certain classes of chemicals.

3. Legislation for Environmental Protection in New South Wales

3.1 The Role of the State Pollution Control Commission

The State Pollution Control Commission Act, 1970, requires the Commission to ensure that all practicable measures are taken under that or any other Act for the control of pollution and the protection of the environment and to co-ordinate the activities of all public authorities in New South Wales in respect of those measures.

The Commission views the control of weeds and pests as an important aspect of environmental protection. However, the Commission also seeks to strictly control and, so far as practicable, prevent the entry of hazardous chemicals into the environment. The Commission supports in principle the concept of biological control, and favours a scientifically based and implementable balance between the biological and chemical components of any control programme.

The Commission administers the Clean Waters Act, 1970, which provides for control of all forms of pollution in surface, underground, estuarine and ocean waters. Hervicides are declared "pollutants" under this Act which further specifies maximum herbicide concentrations permitted either in the discharges or in the receiving waters, depending on the use to which the receiving waters will be put.

The Commission also pursues its responsibilities in relation to pesticides through collaborative and co-ordinating arrangements with other departments, most notably the Department of Agriculture.

3.2 *The Pesticides Act (1978)*

The principal Act for protection of the environment in New South Wales from pesticides is the Pesticides Act, 1978, administered by the Department of Agriculture. Under this Act the sale, supply, use and possession of pesticides is regulated and the contamination of food-stuffs by pesticides is mitigated.

Environmental protection is provided by screening procedures prerequisite to registration of the product, together with its container and label; application of the powers for deregistration and for restricting the use of certain pesticides; and, most importantly, by the legal requirement that the pesticide be used strictly in accordance with the label. This final requirement places a heavy responsibility on the Registrar of Pesticides and those who advise him, to ensure that label instructions provide adequate protection for non-target organisms and the environment generally. It further places a responsibility on all users of pesticides and their supervisors to ensure that label provisions are strictly followed.

3.3 *Legislation Administered by Other Authorities*

Other authorities also administer legislation relating to pesticides. Most of this legislation concentrates on aspects of human health and safety but the applicatcn of such controls can also lead indirectly to control of the introduction and spread of a pesticide into the environment.

That legislation includes:

* *Dangerous Substances Regulations (1978) Section 123 under the Public Health Act, administered by the Department of Industrial Relations, which covers safe handling of around 70 "scheduled" pesticides by commercial operators and includes clauses covering aerial application of pesticides as well as aspects of storage, spillage and disposal of these pesticides.*

* *Dangerous Goods Act, 1975 (Department of Industrial Relations) which deals with aspects of transport of pesticides including minimising escape and treatment of spillages.*

Other Acts relating to pesticides which include the Poisons Act, Pure Foods Act and Stock (Chemical Residues) Act but these do not contribute directly to environmental protection.

4. Recent Developments by the SPCC

Although existing legislation gives control over pesticide use, it does not provide adequately for environmental protection, i.e., in the final disposal of containers and waste pesticides. Furthermore, the extensive controls over pesticides have highlighted the inadequate environmental controls over other classes of chemicals such as industrial chemicals.

To correct these deficiencies, the SPCC is currently engaged in the following three interrelated activities impinging on pesticide use and environmental protection.

4.1 Preparation of Guidelines for Disposal of Pesticide Containers and Waste Pesticides

Although the Agricultural and Veterinary Chemicals Association code "Disposal of Containers and Unwanted Pesticides" has been a valuable reference for a number of years, unsatisfactory disposal of containers is still evident in any area of heavy pesticide usage. Obtaining a concensus on the selection of suitable sites has been a major obstacle in overcoming the problem for pesticide containers. The many enquiries on disposal of waste pesticides received by the Commission and other Government bodies indicates that also remains a serious problem.

The Commission and the NSW Department of Agriculture, drawing on the vast experience gained from the many overseas codes and the AVCA code, are collaborating to compile practical guidelines suitable for Australian conditions. The guidelines will emphasise the following points:

* *Disposal of pesticides in concentrated form increases hazard and limits biodegradation. Waste pesticides should be diluted to spraying strength or below before disposal, as re-use is not possible.*
* *So called "Empty" containers often retain around 2-3% of the formulation unless they have been thoroughly rinsed.*
* *Disposal actions must minimise dispersal into the environment. Effective rinsing of containers at least twice with one quarter of their volume of water and careful disposal of rinsings, preferably into the spray tank, are important. Rinsed containers should be crushed and buried. Choice of a disposal site should take into account the soil type and its distance from surface and ground waters.*
* *Re-use of containers must be discouraged unless by approved methods of recycling or by return, with specific identification and control to scrap or chemical merchants. Drums which are not punctured or crushed could be used inadvertantly by members of the public with risk of environmental damage or human poisoning.*
* *Herbicide containers should not be burnt, otherwise damage to vegetation over a wide area can result from the spread of herbicide vapour.*

4.2 *Participation in the Acceptance of OECD Guidelines*

OECD codes and guidelines for assessing the risk to human health and the environment of new industrial chemicals have already been agreed to in principle and accepted by Australia at the OECD Council. At present agreement on provision of test data for assessment applies to industrial chemicals and therefore is usually considered to exclude chemicals which are already subject to other mandatory assessment, i.e., therapeutic substances, food additives, agricultural chemicals and veterinary drugs. There is no reason why, in the long term assessment of effects on human health and the environment should not be applied uniformly to all chemicals. Relevant authorities might require additional toxicological data for inherently hazardous chemicals and data on efficacy for such chemicals as pesticides and drugs.

The New South Wales Government is supporting these national and international initiatives which include:

1. *Developing tests to assess human and environmental hazard.*
2. *Establishing laboratory procedures which will ensure uniform and reliable test results.*
3. *Developing guidelines for interpreting test data.*
4. *Defining the tests which must be carried out before a valid assessment of environmental risk can be made.*
5. *Establishing procedures for the international transmission of industrially sensitive information by government authorities when assessing environmental risk.*

These pre-requisites to the control of hazardous chemicals have been developed so as to be acceptable to and have the confidence of government, industry and the community world-wide. They help minimize government regulation and effects on the marketplace. They also facilitate the use of legislation which recognises the movement of chemicals through the environment from first introduction, to use and, finally, to the disposal of residues, wastes and used containers.

4.3 A New Environmentally Hazardous Chemicals Act

In concert with international developments, the Australian Environment Council (AEC) has recognised the need to develop a national strategy for the control of hazardous chemicals. Accordingly it introduced a voluntary interim notification scheme" (INS) in October 1981 requesting manufacturers and importers of new chemicals to notify the Commonwealth and provide the necessary information and test data to enable an assessment of potential hazard. This scheme is intended as a forerunner of a permanent mandatory scheme.

The House of Representatives Standing Committee on Environment and Conservation made a number of recommendations in its report tabled at the end of 1982 which stress further the urgency of developing appropriate arrangements for assessment and control of chemicals nation-wide based on both Federal and State legislative action.

In New South Wales the SPCC is developing legislation to satisfy this need. A draft Environmentally Hazardous Chemicals Act is being prepared and will be complementary to and supportive of existing New South Wales Acts regulating specific classes of chemicals as well as being compatible with corresponding legislation by the Commonwealth and other States.

The proposed Environmentally Hazardous Chemicals Act is designed to:

* *Provide for the control of classes of chemicals which are not provided for under existing legislation such as the Pesticides Act.*
* *Require the introducer of a chemical not previously used in Australia, or of a new use of chemical already in use, to supply information and test data necessary to enable assessment of potential hazard by a competent authority.*
* *Extend the above requirement to provide an assessment of existing chemicals where these may present a risk to the environment. Where any existing chemical is assessed as hazardous and the environmental risk is deemed unacceptable, the assessment results will be gazetted together with necessary control measures.*
* *Regulate the handling, storage, transport and disposal of containers or wastes which contain environmentally hazardous chemicals. The previously described guidelines for disposal of pesticide containers and waste pesticides (4.1) are a forerunner to this section of the Act.*
* *Identify sites of environmental contamination or situations of environmental hazard by nature of the chemicals stored or disposed of thereon and order measures to be undertaken to remove or reduce the hazard.*

The development of the nationally based notification and assessment process has involved close liaison between government, industry and the community. This liaison is being continued through the drafting of the State legislation.

5. Conclusion

Chemicals confer major advantages for modern society and the number of chemicals in use has grown enormously in recent years. While many chemicals have little or no adverse effect on man or the environment, some chemicals in commercial use have presented serious environmental hazards. Gazettal and application of the proposed Environmentally Hazardous Chemicals Act will provide a means of ensuring that the chemicals which present an unacceptable risk to the environment can be identified, the likely effects assessed and appropriate controls imposed.

The State Pollution Control Commission has an overall responsibility for environmental protection in New South Wales under the State Pollution Control Commission Act, 1970. However in the case of herbicides, environmental protection is also provided for under the Pesticides Act, 1978, administered by the Department of Agriculture. The controls on the use of pesticides which are determined through the registration process take account of the potential for environmental contamination. If the environment is to be protected, it is essential that spray operators read carefully registration conditions of use printed on the label and follow all of its directions. Supervisors should ensure that the equipment and site conditions necessary to comply with label directions are available during all stages of pesticide handling.

Disposal of containers and waste pesticides is provided for in various advice materials and these are being consolidated as a government policy guideline. However, it is up to the supervisors to ensure that the system for handling of empty containers and waste pesticides is the most effective available to minimise pollution.

6. Acknowledgements

The assistance of Mr. B. Janes and Dr. D. Leece of the State Pollution Control Commission, in reviewing the draft of this paper and offering helpful techincal comments during and after its preparation is gratefully acknowledged.

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Parthenium Weed

By Clive Willmot,
Weeds Officer,
Moree Plains Shire Council.

P A R T H E N I U M W E E D - WILL IT CROSS THE BORDER?

This was my introduction to Parthenium Weed and the words were written in large bold type heading on a AGNOTE received from the Department of Agriculture in September, 1976. The note stated and I quote.

The Weed

Parthenium Weed (Parthenium hysterophorus) also called "ragweed" and "whitetop" in Queensland was probably introduced to the Central Highlands of Queensland as a seed contaminant in 1958.

There is an earlier report from southern Queensland in 1955, but it did not spread. In central Queensland there was limited spread during the period 1959 to 1973. After good winter rains in 1973 the weed was reported along roadsides around Cleremont in the latter half of that year. Spread had continued southward. The most recent report, 27th August, 1976, places the weed at Surat, 500 km south of Cleremont.

Several infestations of over 10,000 Ha are known in Queensland. The weed has become dominant and excluded better species. Likely aggressiveness in N.S.W. is, as yet, not known. It can be expected to establish here, but its persistence is another matter.

Parthenium Weed is now only 200 km away and may enter N.S.W. this year. If it does it should be destroyed.

The Plant

The plant is a short-lived annual with erect stems, sometimes growing to a height of 2 metres. The lower leaves are deeply dissected into narrow, pointed lobes, the upper leaves are smaller, narrower and less dissected. Leaves and stems are covered with soft fine hairs and and the leaves are a dull green in colour.

Individual flowers are very tiny and are compacted into white rounded heads about 10 mm across. Heads are at the tip of a slender branch that is part of an open, much branched flower cluster (panicle) at the top of the plant. Each flower head usually contains about four (4) tiny black seeds with thin white concave appendages, on each side. Ripe seeds are shed freely and probably germinate throughout the year. Four (4) or more successive crops of seedlings may come up in the one season on the same site. Precise seasonal conditions needed for germination and growth are still under investigation. Field experience and the history of the spread of the plant in central Queensland suggests that favourable seasons are those with good rain in both summer and winter.

At the bottom of this note was hand written, "If you find it let me know as soon as possible." Signed, D.A.

On receiving a warning of a weed such as this what are your first impressions? You have been given a description of the plant which could be related to other plants within your area that you know are not parthenium, then you ask, what is Parthenium Weed? What does Parthenium Weed look like? Where are the most likely places to find it growing? Where do you look? Who do you contact for more information for positive identification?

Your first thoughts are your weeds reference books. In the reference books I had access to (6) there was no reference to Parthenium Weed. A request was then made to the Field Officer for Weeds, Department of Agriculture, for assistance in identifying the plant and to supply photographic slides or photographs of the plant. The Department obtained slides from the Cleremont area which I received a short time after. These slides were of great assistance.

In April, 1977, I contacted Mr Haseler, Director of the Biological section of the Allan Fletcher Research Station, Queensland. Mr Haseler advised of the large scale containment programme that was under way in Queensland, and also forwarded a supply of informative publications and pamphlets for distribution.

In May, 1978, the campaign for Parthenium Weed was being stepped up. Parthenium Weed had been located some 20 km north of Goondiwindi, Queensland (140 km from Moree).

The Queensland Department of Primary Industries extended an invitation to the Department of Agriculture, Local Councils, Pasture Protection Boards, and N.S.W. landholders along the Queensland border area to a Field Day at Goondiwindi. From this Field Day there were many firsts and many truths to be learnt.

This was the first time that you had seen the actual plant (somewhat different to a photo slide) and the first time you had a first hand knowledge of people that had been involved with the plant for a considerable time. Many home truths were brought home to many, like myself, who probably had been sitting on the fence hoping the plant would actually show itself and the usual run of treatment of chemicals would treat it.

It was pointed out by Mr Haseler at this Field Day that the plant was from the north and the south of America and was actually wide spread in the Americas and was not a pasture problem plant in its natural habitat. The plant was first introduced to Australia in the early 1950's possibly with straw packing. The potential parthenium growth in Australia is great. It will grow in any environment in Australia and could become a national problem. In Queensland at that time, in all, it covered more than 1,000,000 acres or more than 2,500 square km mainly from minor to major infestations, cattle disappeared from sight in it. Today its threat is being equated to that of prickly pear which covered more than 60,000,000 acres at its peak in 1920.

In ideal conditions the seed would germinate in 48 hours and the plant would flower four (4) days - the plant had a life cycle of 28 days. Depending on the rains it would grow at any time of the year and would flower at any time and the plant would mature four times per year in one area. Each plant has in excess of some 17,000 seeds, it is unknown to what a plant can produce for one season, it will survive drought, it is an annual and is most suitable to black soil.

Parthenium Weed can cause contact dermatitis to man and also allergic skin reaction in livestock.

With the information from the Goondiwindi Field Day a Parthenium Weed programme within the Shire area was put into action.

1. *Council were informed of the findings at Goondiwindi and the extreme threat of parthenium and their full support was given for any control measures required.*
2. *The local media was made aware of the plant, articles were printed in the local papers. The local radio station used it as a news article, also as a talk back programme involving Council Weeds Officer and landholders.*
3. *The local State and Federal Parliamentary members were also notified and took the message to Government.*

The reactions from the public from these media releases were outstanding in so much that the public reported findings of strange weeds that they were positive these plants were Parthenium Weed. These reports created much work for the weeds section of Council as all reports and findings were inspected. Of all areas reported the most common weed reported was found to be "Bishop Weed". No Parthenium Weed resulted from these inspections.

4. *All stock saleyards, holding yards, truck rest areas, stock routes, stock border crossings, main roads from Queensland into the Shire were checked. These checks are still made on a regular basis.*

There remained one problem - the Goondiwindi area was on the border of a neighbouring Shire. This Shire did not employ a Weeds Officer and Noxious Weed control was that of minor responsibility. To overcome this problem I co-opted the assistance of my friendly Field Officer for Weeds with the Department of Agriculture with whom we carried out inspections of all likely areas of parthenium germination within the neighbouring Shires. At the time these inspections were carried out there was always a liaison with the Department of Primary Industries,

Goondiwindi on the movement and works with Parthenium Weed. These inspections have been carried out on a regular basis throughout the years.

With the amalgamation of the Shires in 1981 it is no longer necessary to hide behind the skirts of the Department of Agriculture as the area has now become under the control of Moree Plains Shire.

Whether it be by foresight that this was to happen with the early vigilance of the area no one will ever know, but I feel the exercise has paid off in so much that six years after that advice had been received there was a weed called parthenium. Parthenium has been found in three (3) locations within the Moree Plains Shire. Parthenium has also been found in the south adjoining Narrabri Shire. The Weed Officer from Narrabri, Ron Baker, and myself have had constant communication over the past six years and I think him for his co-operation with our search for Parthenium Weed along with other problems (cotton and hyacinth).

There have been constant warnings of Parthenium Weed to landholders over the past years by written letters from the Department, also information circulars, Parthenium Weed surveillance reports and periodically local media releases are made.

At this point I would like to refer back to the main message that was perceived from the first Biennial Conference at Wagga Wagga by the principal Agronomist (Weeds), Dr L. Smith,

"That we need to constantly take heed of the 3 C's - Communication
Co-operation
Control."

Parthenium Weed in the Moree Plains Shire - the system of the 3 C's stands out.

1. *<u>Communication</u> - has taken place with the Department of Agriculture and Officers, Local Councils, immediate adjoining Councils, Pasture Protection Boards, media outlets, Landholders and the general public, and Government and Local Government Departments of Queensland.*

2. Co-operation - This also involves the above bodies plus local Parliamentarians. For without communication there can be no co-operation from Government Departments, Councils, general public and employees.

3. Control - Here again communication and co-operation combined are the means of successful control, in so much that the findings and latest technology on the control of Parthenium Weed in Queensland are freely passed to this State. This is a time saving factor and allows for an up-to-date control treatment to be carried out. All known Parthenium Weed infestations in the Moree Plains Shire and adjoining Shire of Narrabri have been treated and a constant surveillance is being kept of the infestation areas along with all areas within the Shire.

As in the past the 3 C's have been observed and will remain to be not only for Parthenium Weed but for all problems arising.

Serrated Tussock Control in Marginal Tablelands Areas of N.S.W.

The Problem

By S. Dickman,
Weeds Officer,
Wingecarribee Shire Council,
November, 1982.

Introduction

In the Southern and Central Tablelands Regions of N.S.W. large areas of land could be classified as Marginal Country because:

(1) They can only be handled by aerial means.

(2) They are difficult to manage and extremely costly to fence,

(3) They have a low stock carrying capacity on both unimproved and improved situations,

(4) They have a low real estate value,

(5) They have an erratic and low rainfall (down to 550 mm per year).

These types of areas are rapidly becoming heavily infested with serrated tussock and developing into Mother Load areas which continually contaminate the surrounding country.

Cost of Treatment

Treatment of this type of country could only be carried out from the air, and if the job was done properly the cost of treatment could exceed the value of the land.

The following example is typical of the costs involving work carried out where complete eradication is the goal in unsupered native country.

Aerial spraying	=	$ 15.00 per Ha.
Chemical	=	$ 45.00 per Ha.
M.O. Super	=	$ 40.00 per Ha.
Pasture Seed	=	$ 37.00 per Ha.
Inoculating and line coating of Seed	=	$ 1.50
Ant Treatment	=	$ 3.00
Rabbit Control	=	$400.00 200 to 400
		$541.50 +

These costs do not include ground support crews, markers, transport, etc.

Marginal country has been selling for as low as $25.00 per Ha. though the normal range is $80.00 to $120.00 per Ha.

Control costs alone in the first year greatly exceed the capital value of the land. You would need the courage of Daniel and the faith of Billy Graham to put money of this size into todays cost price squeeze. The B.A.E. Agricultural surveys show returns from higher rainfall properties based on grazing enterprises to be one of the lowest of all enterprises and localities in Australia.

If the landholder considers he is unable to afford the full treatment he may decide to carry out spraying only, and allow the country to regenerate naturally, which could be a very lengthy process, especially if the tussock has been dense and smothered out the native pasture.

It would also leave extensive bare areas which would invite an influx of other weeds and production benefits are likely to be low to nil.

Other Issues

A. *To date there are no native pasture species seed available to sow varieties, that could survive in this type of country, in times of drought. The current range of species for serrated tussock control is also very limited. Basically one legume, sub clover and phalaris. There is a case for developing an improved strain of phalaris for acid soils and a hard seeded sub clover for the tablelands.*

B. *In some Crown Land areas there are large tracts of Crown Land infested with tussock, with limited finances available, the prospect of having these areas treated look very bleak indeed.*
Some landholders who are holding Crown Leases which have become infested from outside are caught in a catch 22 situation, where the land has become unproductive and if they attempt to cancel the lease the Department of Lands may refuse to accept it back until it is restored to its original condition.

C. *Where Forestry is possible reafforestation can be helpful to act as a buffer zone against tussock infestation as tussock does not thrive in heavily wooded country and the timber tends to trap the airborne seed.*

In more open country windbreaks of Pinus Radiata are effective if strategically placed to help trap the windblown seed, thereby reducing the amount of infestation which can be dealt with in a normal maintenance programme.

The Forestry Commission appear reluctant to accept the need for plantations in marginal production areas for noxious weed control. Government should consider this as a community control strategy. With the magnitude of the problem there is something to be said for more participation by Government, possibly by subsidising the cost of the chemical to the landholder.

Having no heavy ground cover, these areas have to pay a production penalty.

Loss of pasture, then oversowing problems are compounded by the need to use spray up to 3 times, which means your chemical spraying costs along can be $120.00 Ha.

As contentious as it may be, consideration could be given for more of the marginal country to be handed over for National Parks where they are not viable rural holdings. These areas could then be reafforested and with natural regeneration would create buffer zones.

A point to remember, we are dealing with low rainfall, low fertility combined with acid soils with a need for lime, which cannot be applied from the air.

At present we do not have suitable agronomic techniques for non-arable acid soils in steep and stoney areas. These areas should never be cleared.

In conclusion, I hope this draft of my observations has provoked a few thoughts on this community problem, and will stimulate more interest and ideas for follow-up action.

Alligator Weed
A New Problem
A New Approach?

By Brian R. Charlton,
M.I.E. AUST.,
Consulting Engineer.

Alternanthera Philoxeroides (Alligator Weed) was first noticed in Australia when found in ships ballast which had been dumped to form the banks of the Hunter River at Newcastle. In the succeeding forty years it has spread not only over one thousand hectares in the Hunter Region, but also to a location in the Georges River, south of Sydney, and south-west near Albury which is five hundred kilometres inland.

Nearly ten years ago it was gazetted a declared aquatic pest for the whole of the State of New South Wales. In July, 1980, at the instigation of Mr N. Vane, who was, at the time, the Regional Director of Extension with the Department of Agriculture at Maitland, the inaugural meeting of the Co-ordinating Committee against Alligator Weed in the Hunter Region was held. In September, Port Stephens Shire Council, having the dubious honour of possessing the largest area of infestation of this weed, accepted the secretarial duties of this Committee.

Under the chairmanship of Alderman John Price of Newcastle City Council, and with the assistance of a $5000.00 Special Grant from the Noxious Plants Advisory Council, the Committee began its appreciation of the problem. This Alligator Weed Committee was composed of representatives from the adjoining Local Government areas of Newcastle, Greater Cessnock, Singleton, Scone, Maitland, Port Stephens, Dungog and Lake Macquarie, of the State Government Departments of Water Resources, Public Works and Agriculture, of the Commonwealth Scientific and Industrial Research Organization, the Hunter District Water Board and the Hunter Valley Conservation Trust.

Including the above, a mailing list of some forty addresses was used to ensure that the Committee Minutes were widely disseminated.

The early work of the Committee was in:

a) assisting the C.R.I.S.O. in its task of finding suitable biological control measures.

b) assisting in finding any practical chemical control methods.

Agricultural chemical companies, the Department of Agriculture at Orange, and Mr Ken Bunn, the Weeds Officer at Port Stephens Council, have all made a strong contribution in this regard.

While an early goal of the Committee was to find a selective weedicide, initial trials showed that a more realistic goal would be to find ANY weedicide that would work. Subsequently weedicides were tried together with the introduction of competing plants of other varieties.

c) recommendation of proposed changes to the Local Government Act.

d) publicity.

e) determination of the physical extent of the weed, and of its rate of progress.

f) taking immediate steps to reduce the likelihood of transport of the weed in turf.

g) the inspection and eradication of Alligator Weed where this is possible. This was complicated to some degree by the introduction of the Pesticides Act, 1978, and the fact that no known weedicides appeared to have a permanent effect.

Valuable assistance was provided by the staff of the Registrar of Pesticides.

h) assessing the potential danger of this weed and its place in the noxious weeds heirachy, both in the previously mentioned areas and to the rest of Australia.

The Committee's early work, I believe, was inhibited by the unfortunate choice of the common name of the weed, which may have tended, together with its innocent appearance, to allow it to be treated in a jocular, or off-hand manner.

I would submit to the Second Biennial Plant Control Conference for Local Government the thought that the Co-ordinating Committee against Alligator Weed in the Hunter Region is, through its members, continuing to determine the best means of impeding the spread of this Noxious Plant, and perhaps the best means of stabilizing or even reversing its unwelcome incursion.

References: 1) *The Biology of Australian Weeds - Alternanthera Philoxeroides by Julian and Broadbent.*

2) *Co-ordinating Committee against Alligator Weed in the Hunter Region .... Minutes.*

Groundsel Bush

By Don Armstrong,
Chief Weeds Officer,
Far North Coast County Council.

The Plant

Groundsel Bush (Baccharis halimifolia) is a native of tropical America, and was first introduced into Queensland as a garden shrub during the latter half of the 19th Century, being first recorded as a naturalized plant in 1888. For the first fifty years of its establishment in Queensland, it was restricted to swampy areas, but in 1937 invaded pastures in the Cooroy-Eumundi area, and spread rapidly from that point.

The first recorded incidence in N.S.W. was at Terranora on the Tweed in 1941, which was followed by a rapid general spread over the Tweed-Richmond areas by the late 1940's. The southward spread continued, and by 1949 the plant was found in Bellingen Shire, and to date has advanced as far as Kempsey.

An erect growing shrub, up to six metres in hight, mature plants average 3 to 4 metres in good conditions, and flower from early April, through May, with seasonal variations. Male and female plants flower separately, the males flowering first, the flower heads being small, pale yellow, and occurring in small groups. The females flower up to a fortnight later, and the flower heads are white and in large clusters, giving the plant a fluffy appearance as the flowers mature. The plant does not flower in its first year of growth, but is capable of spectacular growth in the second year, rates in excess of two metres being recorded under suitable conditions. Seed is windborne, being carried by a fluffy pappus or parachute.

The Plant as a Weed

Once the plant is established in an area, invasion of surrounding land is rapid. A two year old female plant can produce up to 10,000 seeds, and a mature plant on subsequent flowerings will produce in excess of 40,000. The seeds average 95% viability, and remain so for 2 to 3 years.

Although the seed is windborne, the majority fall within 30 to 50 metres of the parent plant, only some 2% having the ability to stick in the pappus; and travel an indeterminate distance. The actual distance travelled is not definite, but it is evident, from isolated plants found in the western areas of the Upper Clarence, that the seeds are capable of up to 50 km travel. 2% does not sound an alarming figure, but 2% of a moderate (30 plant to acre) infestation, can amount to 20,000 viable seeds, capable of infesting in diminishing percentages, a radius of 50 metres to 50 km from the parent plant.

The actual infestation rate usually amounts to about 100% in area, and 200% in density, until saturation point is reached, usually in about 3 seeding seasons. A small undetected, or untreated infestation of a few plants, can become a dense impenetrable clump of weed in 3 to 4 years.

Although not generally considered poisonous to stock, some suspected cases have occurred. It has no nutritional value, however, and cattle forced to graze on heavy infestations tend to debilitate, and waste quite rapidly.

Groundsel Bush has no particular preference for soil type, and will flourish in all situations found east of the dividing range, in Southern Queensland and New South Wales. Once established it thrives over the full range of soil types and conditions, from the coastal sand dunes, and tidal swamps to the foothills of the dividing range, although establishment is slower in the lower rainfall areas inland. The plant is frost tolerant, and does quite well in the Upper Clarence area, where winter conditions often approximate those of the tablelands. In America the plant grows in areas subject to snow during an average winter, ranging from Florida to Massachusetts. It grows as a weed in the south western areas of France, from the Loire River to the Spanish border, and has been documented as a weed problem on the shores of the Black Sea in Russia.

In Queensland, where the plant has had a longer period of establishment it is found over virtually the whole of south eastern Queensland, from the N.S.W. border, north to Miriam Vale, and west to the dividing range, an area of some 5,000,000 ha of which some 250,000 ha are actually under infestation. When one considers that this is the highly productive coastal belt, the value of the land taken out of production is staggering.

The only factor inhibiting the northward and westward spread of the weed appears to be adequate rainfall. Taking the spread of Groundsel in America as a guide, comparable lattitudes in Australia would give it a spread right down the east coast, and include Tasmania. Rainfall would also appear to be adequate to facilitate this.

Control

Small initial infestations can be removed mechanically or manually, and large mature infestations can be satisfactorily cleaned up mechanically, providing suitable vigorous pasture species are introduced as a replacement. Molasses grass, Setaria, Green Panic and the tropical legumes are suitable competitors. Reafforestation is also applicable, but requires considerable mechanical or chemical maintenance until the trees form sufficient canopy cover to inhibit weed germination. In steep areas, such as old banana land, which is unsuitable for grazing, reafforestation is the only practical long term control for the problem.

Chemical control is effective, the most practical on large scale infestations being a foliar spray of 2,4-D Amine at solution rates of 0.20% to 0.25% with seasonal variations. Wetting agents are not generally required.

Smaller, or scattered infestations may be treated by the cut stump method, using 1% solution of 2,4-D Amine in water, or 4% solution of mixed esters of 2,4-D, 2,4,5-T in distillate or power kerosene, to swab the stumps after cutting. It is essential that the stumps be swabbed immediately after cutting, particularly if 2,4-D is the chemical in use.

Large bushes, or scattered plants may also be treated by basal bark spraying with the same solution of mixed esters used for cut stump treatment.

Aerial spraying where applicable has proved highly successful, and with the labour content of hand spraying becoming more expensive, has also become more economically attractive. Helicopters are being used, as the terrain of the north coast area does not lend itself to fixed wing aircraft operations of this nature. The application of 6 to 10 L of 2,4-D Amine in 19 L of water per hectare is giving excellent results, even in massive mature infestations. Present costs of around $80.00 per hectare make this type of treatment quite practical for large heavy infestations, or infestations in inaccessible areas.

The basic requirement for any eradication programme to be successful is of course the establishment of a vigorous productive competitor to replace the Groundsel Bush after eradication.

Biological Control - Co-ordinated Project N.P.A.C., Department of Agriculture and Far North Coast County Council

In the light of present economic conditions and the reduced real value of funding available for noxious plant control it has been necessary to revise some of the policies and attitudes which have prevailed in the past. It is now necessary to review priorities, with more emphasis being placed on productivity and cost-return. A "strategy control plan" is now being developed in co-operation with Special Agronomist, Weeds, based on agricultural capability of land, using the Department of Environment and Planning document, "The Rural Land Evaluation Manual".

An integral part of this strategy calls for the containment rather than attempted eradication of a number of major infestations on land of little or no agricultural significance. This requires the formation of buffer zones of suitable width around these infestations, to protect adjacent viable land. The actual width of these buffer zones varies from 500 m in open country to 200 m, in timbered areas. The situation which lends itself to containment, is usually found in a National Park or Nature Reserve area, Forest or some development projects which are either at a standstill, or proceeding slowly.

As part of the new concept of increased co-operation between the Department of Agriculture, and Local Government authorities, the Regional Director of Agriculture, North Coast Region, Mr Noel Vane, arranged a joint study tour, and conference to Queensland, to observe control methods being carried out by Queensland Department of Lands. Those involved were Councillors and senior staff of the Far North Coast County Council, and senior Department of Agriculture officers. Queensland representatives came from the Department of Lands, Stock Routes and Rural Lands Protection Board, and staff and the Director of the Alan Fletcher Research Station, Sherwood, where the conference took place. Field studies were conducted in the Burpengary, Caboolture, Deception Bay areas.

The Alan Fletcher Research Station is presently the foremost authority on Groundsel Bush, and major projects on biological control have been carried out here over the past decade. The Director of the Station, Mr Bill Haseler has indicated willingness to co-operate with N.S.W. authorities in the provision of suitable insects for release at a series of test sites in the Groundsel Bush infested areas of north eastern N.S.W. The sites selected are in National Park and Forestry areas, to ensure that there will be no change in land use that will disturb the trials in progress. As biological control is a very long term concept, this is of the utmost importance.

The most suitable insects for the present requirements would appear to be as follows -

1. Trirhabda Bacchardis This is a foliage feeding beetle, which lays eggs in the spring, which are hatched in late summer-autumn. The insects feed heavily, causing an annual defoliation in the autumn, then winter in the soil. The defoliation coincides with the flowering period.
2. Megacyllene Mellyi This is a stem boring beetle, which feeds under the bark of the plant, creating a ring-bark effect.
3. Rhopalomyia California This is a gall-forming fly, which causes stem galls on seedling plants, effectively preventing maturity. There is a problem with this insect, however, as it may be itself parasitized by other insects.

Special Agronomist (Weeds) is co-ordinating this project, which, if successful, will considerably lower the cost of control in some of the difficult heavily infested coastal areas.

New Dimensions in Noxious Plant Control

By Leon W. Smith,
Principal Agronomist (Weeds).

We live in a rapidly changing world both in attitudes and in technology. We must be prepared to consider and accept many of these changes, otherwise we'll be left behind and ignored.

New Attitudes

1. Our philosophy to weed control must change as other factors around us change. Today we talk more about "containment" or "management" rather than "eradication". The cost of eradication of some noxious plants may be beyond the resources available to us. We must recognise this and accept it. If we have only small infestations or are trying to prevent the introduction of a new weed such as Parthenium weed then we may be able to eradicate it, before it gets too big. However, we may often have to learn to live with the problem and manage it to our best advantage, i.e., blackberry or Patersons's curse.

2. The status of weeds may change, i.e., water hyacinth can be utilised to make paper in some parts of the world and is being investigated for many uses; cumbungi is being investigated as a purifier of waste water by CSIRO; variegated thistle is commercially grown in Tasmania to extract chemicals from.

3. Today other people's viewpoints must be considered and any conflict of interest sorted out, their "livelihood" may be at stake, i.e., blackberries in Tasmania, Paterson's curse for beekeepers and graziers.

A new dimension has been added to weed control by the attitudes of these minority groups. Often the media support these views because they are controversial. The Paterson's curse case has resulted in a special Working Party being set up by Standing Committee on Agriculture to examine the need for and made recommendations on legislation that may be necessary at Commonwealth and State level to overcome the problems posed to biological control in general by these conflict of interest groups.

4. I believe that our philosophy today should be not to rely solely on one method of control, i.e., chemical or biological but the situation should be examined and the long term consequences of any action we carry out must be understood. A plan of action should be developed over a number of years, i.e., a 5 year plan drawn up, which utilises to best advantage all the methods and knowledge available. For example, a farm dam full of noxious weeds. If we continually treat the dam with chemicals we may create a worse problem than we started with, i.e., weeds not controlled by chemicals flourish, alligator weed cleaned up in the Georges River has now been replaced with Salvinia.

A better plan might be to see what is causing the weeds to flourish, divert water away which is full of nutrients, put a block of ferric alum in the dam to soak up all phosphorous, plant some trees around the dam to shade the water surface and generally discourage the growth of the unwanted plants or weeds.

New Technology

1. Another new dimension in weed control techniques is to study the buried weed seed pools in the soil and see if we can manipulate them to our advantage and eventual control of the species concerned.

Everyone knows of the tremendous potential for weed growth that exists in the soil from weed seeds. Dr R. Medd at Orange has been granted Wheat Industry Funds to study this technique. An example of the value of this method, for instance, would be that if we could stimulate weed seeds to germinate at once by some treatment we could treat them with herbicide or kill them with cultivation.

In the Gingham Watercourse at Moree, Dr John Duggin from U.N.E., Armidale is studying the water hyacinth seed pools that exist there and we hope his work will lead us to understand and be able to manipulate and control them.

Another practical example of successful use of manipulation of weed seed pools is in North Carolina, U.S.A., where they have 'Striga' spp., a parasitic weed from India, which grows on corn roots. Research found that ethylene caused the seeds to germinate and then die because of a) herbicide treatment or b) there are no host plants to grow on.

This technique has great potential for control of weeds such as thistles - if we can unravel what causes them to germinate maybe we could control the nodding thistle problem this way.

2. New weeds appear from time to time and will add dimensions to our problems. Parthenium weed is now with us and we must be vigilant at all times for this and any other new weed we see.

3. New Dimensions in Herbicides

The development of new herbicides has slowed over recent years and fewer new products are discovered and developed today than 10 or 20 years ago.

However, we are finding new uses for old herbicides as evidenced by the work being done in Queensland by the Alan Fletcher Research Station where new formulations of 2,4-D and other chemicals have been developed, i.e., odourless formulations of 2,4-D acid is one example. These are now being preferred by authorities in Victoria and Queensland and could be used in future in N.S.W. You can't smell anything when using 2,4-D and this has obvious advantages, i.e., the public can't smell it.

Some new herbicides have been introduced and we've seen GLEAN(R) come on the market which can be used at extremely low rates, i.e., 15 - 25 g/ha and which has both pre and post emergence activity.

A herbicide which shows both soil and foliage activity can be advantageous if it is selective for the crops or situation concerned. Garlon(R)'s effectiveness is partly attributed to both soil and foliage activity and a mixture of picloram and trichlopyr is extremely effective on blackberries because it exhibits both soil and foliage activity.

Preference in future will be given to water soluble, post emergence chemicals used at low rates, i.e., GLEAN. These types of chemicals are energy efficient, a definite advantage today.

i.e., - they don't need incorporation.

- they only need to be mixed with water.

- no oils are involved in the formulation.

- minimal energy is used to manufacture them at the rates used.

4. *Application Technology and New Dimensions*

New dimensions in application technology are being added almost daily to our knowledge of application of herbicides. This particular area has languished for many years and has only recently been revived. It's obvious that we can apply herbicides just as effectively at low volumes as at high volumes. We've seen CDA applications, ropewick applicators, various low volume spot spraying guns, (splatter gun, spot gun).

More recently, we have seen the development of the "Electrodyne Sprayer" by ICI where spray particles are positively charged (+) as they leave the nozzle and thus are attracted to plant surfaces which are negatively (-) charged. Thus more spray particles attach themselves to the plants surface and the chemical is placed where you want it.

This, probably, has more application with insecticides and fungicides, but if we could differentiate between crop and weeds it would have wider application with herbicides. Nevertheless there is a place for this type of equipment to get the chemical where you want it and thus lowering the rates of use and the chances of environmental contamination.

5. *Biological Control*

Biological control programmes will be developed for many new weeds and Dr del Fosse, on Friday, will speak about some of them.

New programmes are being investigated by the W.A. Department of Agriculture who are working on Docks ('Rumex' spp.), the Queensland Department of Lands who are looking into the use of biological agents for use on Noogoora burr, Ragweeds, Parthenium weed, Giant Sensitive Plant, etc., the Northern Territory D.P.I. are developing a programme on 'Sida' spp. and 'Parkinsonia' spp., the CSIRO has the aquatic weed control programme in Brisbane and the Mediterranean type weed unit in Canberra and the Victorian Department of Crown Lands and Survey are working on blackberries and ragwort. There's a lot of work going on with new programmes.

The big problem or new dimension which has influenced these programmes is the "conflict of interest" which we saw arise in the case of Paterson's curse and the action taken by a group of graziers and bee-keepers to stop CSIRO from releasing the agents.

Already we see this developing in the case of blackberries from the Tasmanian beekeepers. Also if any native species of plants are involved, such as with 5 native docks species in N.S.W. then conflict may arise. Legislation is going to have to be developed to cover these situations and as I mentioned earlier a special Committee has been set up to look into this and make recommendations.

Another factor causing concern is the high cost of biological control programmes and CSIRO have had to cut back on their work.

A new development in biological control is the use of what is called the "Innundative Method" of biological control. With this method an agent is found, maybe occurring naturally, which affects the plant but does't build up in large enough numbers quick enough to cause great harm. So this technique plans to breed up large numbers of the agent and release them all at once on the weed. It may be a disease or an insect or even an extract of a diesease virus.

It works like a "biological herbicide" with no long term toxic effects, but it affects the roots or flowering or seed set of the plant-weed to reduce its growth and control it.

Dr Auld of N.S.W. Department of Agriculture is going away on a Churchill Fellowship to study this technique overseas. I think it has promise.

6. *Legislation and New Dimensions*

We've seen the introduction of restricitons on the use of 2,4,5-T in N.S.W. and Victoria which severely restricts the use of 2,4,5-T and I think the product will eventually disappear from our list of herbicides mainly because there are many alternatives available.

Unfortunately I think more restricitons will be placed on the use of pesticides in future such as - registration of users is possible

- restrictions on use of hazardous substances, i.e., paraquat and the 'Paraquat Report'.

Our record in the past has not been good and many instances have occurred of misuse and the media blowing these up out of proportion. It's a fact of life that we all face more questioning of the use of chemicals and their effects on man, animals and the environment.

All this places a new dimension on our spraying activities and the need to know what is involved when we treat the target as well as non-target species. Also the Trade Union movement has placed a new dimension on our activities but we must be prepared to defend the use of chemicals and herbicides, in particular, against adverse publicity. We must be seen to be doing the right thing by - proper precautions,

- right chemical for the situation,

- no misuse.

7. *Education, Training and New Dimensions*

New courses in the use of pesticides (herbicides) have been developed in recent years.

- *Course at Wagga - RCAE to train inspectors.*
- *Short Courses in Technology at QAC, Gatton, Queensland*
- *Operator training course developed by H. Milvain and being offered to D.M.R. personnel (expanded to others in future).*
- *Seminars and conferences put on by N.S.W. Department of Agriculture.*

There is a continual need for courses of this type to update personnel and to train new people entering the area. To keep track of the changing control methods, recommendations, legislation, etc., we need a continual educational input from newsletters, seminars, conferences, etc.

New dimensions have been added to our weed control programmes by Des Thwaites and his talks on motivation, public relations, communications, etc. We have all benefited. We must thank Roche-Maag for this and we need to take heed of what Des has said.

This dimension of our weed control work must always be kept in mind - public relations, communication, personnel development.

I feel that we must go further and develop a better image for weeds officers in the community as responsible, humane, specially trained officers, who understand all aspects of weed control and protection of the environment.

In Victoria they are now changing the title of their weed inspectors to Land Management Officers or Land Protection Officers to help overcome an image that has developed as vermin and noxious weed inspectors.

The building of a respected image for Weeds Officers is essential and adds another dimension to the noxious plant area.

8. Lastly I want to briefly mention "Integrated Weed Control" or "Vegetation Management".

These are the "in words" today. The principle is to integrate or to apply as many strategies as possible to the weed problem, i.e., natural enemies, cultivation, competitive crops or plants, herbicides, soil and water management.

All these strategies are blended into a long term plan which reduces the weeds to levels which do not cause economic harm - learning to live with weeds.

You might say this is idealistic and can't be achieved, but with the technology we have today nothing is impossible. It's even been suggested that we can take a gene from a bacteria that degrades a herbicide and put it into a crop plant to achieve selectivity - "genetic engineering" so that we gain an advantage over weeds that don't have this gene.

There are many other New Dimensions in Weed Control that you will hear about from other speakers at this Conference. I've only touched on a few. Others include - use of Landsat - a tool in weed management, Indian Hemp detection.

- *The use of computers in weed control.*
- *Des Thwaites will expand his management theme.*
- *Vegetation management on roadsides.*
- *Two sessions will be devoted to application techniques.*
- *Sessions on biological control and many more.*

Conclusions

I trust today that I have widened your horizons and added new dimensions to your views of weed control and especially noxious plants control. The need for changes in noxious plant control is never more evident than today.

We need to develop what is called "lateral thinking" - an ability to expand our thoughts on weed control and get away from the "single minded-ness" which has tended to be the direction of the past.

OPERATOR HYGIENE SAFETY

JOHN EDWIN WHITLEY
Weeds Officer
Scone Shire Council

In early agriculture, pastoralists considered weeds a most insidious problem, as the inevitable, like droughts and floods. Little was done except for mechanical control ploughing and cutting.

Tremendous advances have been made since the war in the field of chemical weed control in crop and pastoral situations.

The hormone chemical 24D first became available in 1945 but its adoption was slow up until about the mid fifties, when its application to control weeds on cereal crops became a viable and economical proposition.

From this time onwards the use of this material on broad acre/ hectare farming has been increased dramatically.

One of the close relations of 24D, 245T, achieved spectacular success on Blackberry control in N.S.W. during 1949.

I have known of landholders and employees who have used the product as early as 1946 in the Upper Hunter area.

Herbicides registered under the Pest Destroyers Act 1945 as at the 1st September 1955, totalled one hundred and sixty. Of a break-down of these 24D Amine 41., 24D Ester 23., Mixed Esters 24D-245T 19., 245T varying percentages of formulation 12. The remainder consisted of Arsenical base, Chlorates, P.C.P., and T.C.A.

It has been my personal experience, over the past quarter of a century, with the application of these herbicides, the hormone type in particular, that the safe use of <u>all</u> irrespective of formulation material should be regarded with utmost care and consideration.

Container labels reveal a mine of information and the time spent studying this before proceeding with the application of the contents is of vital importance.

To conform with the current Pest Destroyers Act, full and complete directions must be given on the label.

A typical label has imprinted on the label the batch number which is usually indented, chemical name, active constituent, specific recommendations, e.g., type of plant to which it is to be applied, Application Methods, Mixing, Caution, (Read the Label Before Using), Safety Directions, First Aid, Warning, Withholding Period, Registration and Conditions of Sale.

Overalls, hats, gloves should be provided and laundered daily, leather boots provided, should be washed periodically. Cloudy Ammonia is a useful agent in neutralising chemicals of the type most encountered by operators

Contact with the skin and eyes should be avoided and if such exposure occurs should be washed with water immediately. Do not work, or be extremely careful if you are breathing the spray mist; a respirator should be worn if such is the case. All exposed parts of the body should be thoroughly washed before meals and smoking delayed until operations cease.

Regular medical examinations by a Registered Doctor are recommended and should it be deemed necessary, a speciman of urine forwarded to the Division of Occupational Health and Radiation Control for analysis; this applies mainly to the exposure to hormone type chemicals. If the level of chemical in the system exceeds 100 parts per billion, the operator will be advised as to the measures to be taken to reduce such levels. This usually is that further exposure is not to take place until the time stipulated and a further specimen forwarded. If such levels are above the cut off level this does not necessarily indicate that poisoning will occur.

Empty pesticide containers should, before disposal, be thoroughly rinsed and re-rinsed with water and poured into the spray tank. Cans punctured and crushed, bottles broken before burial and cartons burnt.

Care should be taken with some toxic substances which produce gases when burnt; this is indicated on the label together with other information previously dealt with.

Cleaning of spillage can be effectively done by covering with soil or sand to absorb the material. In the case of an organic phosphate compound this can be neutralised by using lime, laundry bleach or any other available alkali.

The contaminated soil can be shovelled into drums for safe disposal. The area should be washed down with liberal quantities of water after the effective cleaning of the spillage has been done.

To summarise the information the following points should be considered:

* *Select the pesticide best suited for your area. Your departmental extension officer can help.*
* *Read the label carefully and follow all directions for use.*
* *Use the correct quantity of pesticide and the correct method of application.*
* *Wear the protective clothing noted on the label.*
* *Follow the mixing instructions on the label. Mix pesticides outdoors or in a well ventilated room.*
* *Never apply pesticides outdoors on a windy day.*
* *Do not eat, drink or smoke while handling a pesticide.*
* *Wash contaminated skin immediately. Change clothes after spills.*

* *Use pesticides only for the purposes shown on the label.*

* *Keep equipment in good condition. Empty and clean application equipment after use and store as for pesticides.*

* *Cover feed and water containers when applying pesticides. Do not contaminate dams, rivers, channels or fish ponds.*

* *Observe withholding periods to avoid unacceptable residues in food and feeds.*

* *Dispose of unwanted pesticides safely.*

* *After finishing work, wash exposed skin surfaces with soap and water. Wash contaminated clothing.*

* *Do not save or re-use empty pesticide containers; dispose of them safely.*

* *Store pesticides in original containers, properly closed and in a safe place, locked away from children and pets. Store away from food or feeds, fertilizers, and seed. Keep the label secure and protected.*

* *Make sure you and your employees are familiar with the nature of the pesticide you are using. Know first-aid measures.*

* *REMEMBER: BEFORE USING ANY PESTICIDE - READ THE LABEL.*

The Hazard of Herbicides

By H. J. Baker,
Senior Chemist (Pesticides),
Biological & Chemical Research Institute.

1. Toxicity Rating

Before an evaluation of the hazards involved in the use of herbicides a basic reference point must be established as a guide to further discussion. Just as the efficacy of a pesticide can be established by testing the chemical at varying strengths against target organisms and assessing the degree of control at each level, the potential mammalian toxicity can be determined by appropriate tests on laboratory. While the dose/response relationship gives the complete picture, it is cumbersome to use, so an arbitary level called the median lethal dose or LD50 has been chosen to enable relative comparison of toxicity gradings. The LD50, expressed in mg/kg body weight is that point which 50% of the test animals have died. Since toxicity will vary with the route of absorption into the body the LD50 values are determined for both oral and dermal routes as a pesticide of high oral toxicity may be much less toxic by dermal administration.

Rats, mice, rabbits, birds, dogs and fish are commonly used in laboratory tests but as some animals may react differently to the treatments the LD50 may vary from one test colony to another. Great effort is made to standardize the history and status of the animals. The values obtained are very useful in classifying pesticides according to their toxicity, so long as it is recognised that the values are not absolute and should be expressed as a range.

The LD50 value can then be compared with similar tests carried out on other chemicals. In a scale of toxicities the LD50 values can be classified.

Level of Toxicity	Oral LD50 mg/kg	Dermal LD50
Extremely toxic	less than 5	10 or less
Highly toxic	5 - 50	10 - 100
Moderately toxic	50 - 500	100 - 1000

Level of Toxicity	Oral LD50 mg/kg	Dermal LD50
Slightly toxic	500 - 5000	over 1000
Practically non toxic	5000 - 15000	-
Relatively harmless	more than 15000	

With this grading in mind we can, from a cross section listing of herbicides and common substances -

Chemical	Acute Oral LD50	Dermal LD50
2,4-D	400 - 500	1500
2,4,5-T	300	2000
Atrazine	2000	7500
Bromacil	5200	5000
DSMA	1800 - 2800	-
Paraquat	100 - 200	80 - 480
Picloram	8200	4000
Glyphosate	4320	7940
Trifluralin	10000	-
Tri allate	800 - 2160	-
Table salt	3500	
Aspirin	1500	
Ethyl Alcohol	8000	
Strychnine	20	

see that herbicides can, on this basis be regarded as generally being moderate to slightly toxic. If, as shown in the above table, the acute toxicity of a herbicide to mammals is very low when given as a single dose, the next step is to see whether repeated doses are equally innocuous. Short and long term (life span of the animal plus progeny) at various sub acute lethal levels as well as skin and eye irritation studies are carried out to assess potential acute and long term effect of the chemical. This involved procedure is not done only on extremely toxic chemicals but is an absolute requirement before any new chemical is released. Registration authorities demand a full evaluation of toxicology studies before considering any other data.

For comparative reference the LD50 figures provide a useful ready reckoner as to toxicity of a chemical.

2. *Toxicity and Hazard*

Toxicity is defined as the inherent capacity of a substance to cause injury or death.

Hazard is a function of two primary variables; toxicity and exposure weighted by factors taking into consideration formulation, quantities and manner of application.

A chemical may be extremely toxic but present little hazard if it is used:

1. *In a very dilute state*
2. *In a formulation that is not readily absorbed through the skin or by inhalation*
3. *Only used occasionally and under conditions to which humans are not exposed*
4. *Only by experienced operators who are properly equipped to handle the chemical safely*
5. *Is designed so that no bio-accumulation occurs and/or is non-persistent in the environment.*

On the other hand, a chemical may exhibit a relatively low mammalian toxicity but present a significant hazard because of its use pattern.

In order to assess the true hazard posed by herbicide usage the instances of exposure must be examined.

3. *Exposure to Herbicides*

1. *During Application*

At this point concentrated chemicals are being handled so dermal contact probability is high. Gauntlet gloves and other protective clothing is a must. Since many pesticides are applied as sprays the popular belief is that inhalation entry exposure is high. Since very little of the spray cloud with herbicides is less than 50 micron particle size necessary to enter the respiratory tract, the main exposure is again dermal. Tests carried out by the U.S. E.P.A. using a variety of equipment including air blast showed only 0.5% maximum of the total amount of pesticide landing on the

operator's body entered the respiratory tract. This, of course, can be eliminated by respirators and face masks.

2. From Herbicide Residues

As a general rule of thumb, 1 kg active per hectare will lead to .01 grams/sq metre once applied. With the moderate toxicities of herbicides it is inconceivable that sufficient contact could be achieved to approach any level of contamination.

Food crops from treated areas are subject to restriction on levels of herbicide they might contain by the imposition of maximum residue limits. These limits are not related to toxicity levels but are the maximum levels which should result from treatment. These levels are established by trials carried out both by Industry and government agencies.

Similarly feeding trials are carried out on animals to assess potential contamination of animal foodstuffs.

The residue data from trial and commercial work has shown that due to the nature of modern herbicides and the agricultural practices employed that none of the modern herbicides is sufficiently persistant to provide a basis of any threat through build up in the environment or concentration down a food chain.

Practical Computer Use

By J. Cherry,
Chief Weeds Officer,
Central Northern County Council.

I feel computers are fast becoming a way of life and if we do not utilize this facility, then we are going to miss out and be left behind.

Computers are not cheap to initially set up with the appropriate programmes, however, they are very time and cost efficient in updating available information with relevant material printouts.

Central Northern County Council's accounting records are maintained and kept on the Quirindi Shire Council's NCR 8251 mini computer. Details on timesheets, trucksheets, and stores issue dockets are made available to the computer operator for the various programmes that Council operates. Each of the noxious plants is categorised so that time and chemical utilized for the eradication of each noxious plant can be easily determined.

There are many benefits gained from an efficient system of recording data. It is easy to tabulate and compare the cost efficiency of each of the programmes. Comparisons of wage requirements for each preparation of estimates as well as the completion of the Grant Application. An update of each programme is available after each fortnight, allowing for good strategy planning for the future.

Another aspect which Council feels benefits are forthcoming is by recording property inspection information on computer. At present Council's inspection records and reports are on a card system using a code. The experts indicate this coding system with modification can be adopted to a data processing system.

The anticipated advantages of placing the property inspections on computer include:-

1. Easier updating of Council's records.
2. Automatic reporting on all of the property files contained in the system. The computer will print out a complete list of all files or individually selected files, therefore reducing typing.

A report of reoent inspections made between consecutive meetings can be presented at the next Council Meeting with a special notation made in the Chief Weeds Officer Report concerning any specific points about any particular property.

3. An automatic report can be extracted for files requiring action, i.e., properties requiring follow-up inspections, or properties for which the landholder displayed a less than co-operative attitude, or properties for which Notices have been served.
4. The property file records can be coded as to the type of noxious plant(s) found on each property. Select reports would be available to list by each particular type of plant all those properties affected by that plant.
5. The property file record can also be coded with the degree of infestation of the plant as well as its location. The previous report can then be extracted for all those properties with a particular plant type with, say, a "heavy" degree of infestation. In addition, this report could be extracted also by Constituent Council areas.

There are possibly other fields in which computers can aid the Weeds Officer, however, I feel the two aspects I have covered here today (accounting and property inspection information) would give an immediate practical benefit.

A copy of the existing coding system for property inspections is attached. This can be adapted for computer use.

Central Northern County Council

SHIRE OFFICE, QUIRINDI, N.S.W., 2343

PHONE QUIRINDI 750.

"SCIENCE AIDS THE FARMER"

De-coding Property Inspections Reports

Number: Shire initial plus first 3 letters of landholders surname. Ma - Mannilla, Mu - Murrurundi, N - Nundle, P - Parry, Q - Quirindi and T - Tamworth City.

Property: Name of Property and area- portions and parish if required.

Owner: Registered Owner of property and address if different from above.

Inspections: The number as they appear in the Meeting paper in chronological order.

The type of inspection is A- Full property

B- Part property

C- Advice given - office, telephone, identification.

Meeting: The date on which the property was inspected.

Remarks: The number of the noxious plant. 1. Parthenium Weed 2. Indian Hemp 3. Coca Leaf 4. Opium poppy 5. Johnson grass 6. Columbus grass 7. Mesquite 8. Water Lettuce 9. Bathurst Burr 10. Noogoora Burr 11. Californian Burr 12. Cockle Burr 13. Blackberry 14. Water Hyacinth 15. Salvinia 16. Alligator Weed 17. Lagaro siphon major 18. African Boxthorn 19. Dodder 20. Galvanised Burr 21. Hemlock 22. Long Styled feather grass 23. Mintweed 24. Nodding thistle 25. Patersons Curse/Vipers bugloss 26. St. John's Wort 27. Serrated Tussock 28. Skeleton Weed 29. Spiny Burr Grass 30. Sweet Briar 31. Nuisance Weeds.

Degree of Infestation: H - Heavy, M - Medium, L - Light, S - Scattered, C - Clean

Position: *Overall (% area covered), creek, cultivation, pasture, timber, fences and/or roads.*

Farmers Attitude *A - Co-operatiove, B - Further inspection required, C - Legal action required, D - letter sent.*

Computer Use in Future Weed Control

By R. W. Baker,
Senior Weeds Officer,
Narrabri Shire Council.

The Computer

A man made machine capable of a multitude of functions. One of the many functions is to memorise, store and correlate data, and to reproduce selective information when required.

My topic for this session is to be on general information relating to weeds, the computer and associated functions based on a statewide survey with the information, when becoming available, to cover a fairly broad spectrum.

The first thoughts to come to mind are, is it economical; the type of information required; the work involved in this type of project; will the information collected by worthwhile; and to whom is this information to be made available.

When relating to a statewide basis most information is available in one form or another, but to be able to have access to this information, and quickly, is almost impossible.

Speaking as a Weeds Officer, I know the volume of information that I have accumulated over the years, and like most Weeds Officers, have it stored away in a filing cabinet. Some may say thats where it should stay, but I feel this information could be put to better use.

Firstly, a method of collecting this information on a statewide basis needs to be adopted. There are a number of simple basic methods to use or to standardise on. Most Weeds Officers already use some sort of system that could be adopted as a basic method.

(A) Methods for Locating Specific Areas

Departmental or topographical regions and divisions could be used.

(B) Direct to Shires and Divisons

At this level only general information would be collected.

(C) Counties and Parishes

Information to become more comprehensive and would incorporate the use of parish or the generally used topographical maps. These maps are readily available, covering a wide area of the state and are continually being added to as new maps become available.

(D) Portions

Numbered portions within a parish, this level would be the area where all information would be collected, irrespective of its being part of a property, forest, national park or stock reserve.

Most Weeds Officers constantly use maps of one sort or another when relating to properties and are used on property inspections, this being part of the general recording system.

Benefits

(1) A more comprehensive, statewide weed control programme could eventually be formulated.

(2) An accurate evaluation of damage and losses caused by weeds could be formulated.

(3) Better control and tabulation of the spread of new weed infestation in the state could be recorded.

(4) To find out if methods now in use, to control weeds, need to be improved on to achieve better results.

(5) To start an overall tally of herbicide chemicals used. Shires and Weeds County Councils have already started submitting this information with Grant Applications.

(6) A futuristic approach has got to be taken, the reason being the enormous losses and costs involved in controlling weeds. Numerous other elements involved which may occur are the high costs due to contamination and stock losses; roadside and health problems, etc.

When considering the enormous overall losses and costs involved, weeds seem to be generally given a low keyed priority within the community. Possibly this is due to the lack of sufficient and up-to-date information being available.

Who Would Benefit From This Information

(1) Departmental, Research and Local Agronomist;

(2) Shire and County Council Weeds Officers;

(3) Service to prospective property buyers;

(4) Chemical Companies;

(5) Soil Conservation Service;

(6) Lands Department;

(7) Pastures Protection Boards;

(8) C.S.I.R.O. etc.

Difficulties in Formulation and Distribution of Information

(1) Accumulating the Information

Standard method of recording should be adopted.

(2) Cost of Establishing

Possible backing or support from chemical companies. The information could be included into some existing computer network.

(3) Distribution of Information

Through selected Departments, such as Department of Agriculture; Lands Department; Shire or County Weeds Officers, etc., available either by terminal or by phone.

Sufficient time should be allowed for the accumulation of information is defined in enough detail to become useful to Weeds Officers, etc.

(4) Type of Information

Generally any information pertaining to weeds and weed control. This could have unlimited scope and could be incorporated into other associated projects.

Conclusion

These are some of my thoughts on the subject and I welcome any structural criticism or ideas.

One point that specifically needs to be stressed is that we are all concerned one way or another with a problem which costs multi-millions of dollars and has a major effect on the country.

I feel future consideration must be given to the community, as a whole, being made more aware of the dangers, problems and costs involved. This will only be achieved by a combined effort and the use of modern methods to produce a more informative and up-to-date statewide survey.

Computers in Perspective

By Michael J. Bryant,
Regional Economist,
N.S.W. Department of Agriculture.

The aim of this paper is to explain briefly what computers are, how they work and some of their uses.

Types of Computers

A computer is an electronic device that is capable of performing calculations with great speed and accuracy. Many computers also store information. Computers are available in many sizes and can be categorised into three groups. These are: Mainframes, Minis, and Micros. Mainframe computers are the largest and most powerful, i.e., they can store the most data and are capable of performing the most complex tasks at greater speeds than smaller machines. Organisations with massive volumes of information to store and process own or hire time on machines like these. The Australian Taxation Department, the Australian Bureau of Statistics, the C.S.I.R.O. and the New South Wales Department of Agriculture are examples of just a few mainframe users.

Mini computers are the middle sized machines. They are much less expensive (approximately $40,000 to $90,000) but are quite powerful. Machines of this size are often used by Acccunting firms and in Local Government.

The smallest and newest group of computers are the Micro computers. Advances in electronics technology, particularly the development of the silicon chip (Semi conductor integrated circuits) has enabled significant reductions in both the cost and physical size of computers. The Micro computer is a product of this technology and ranges in price from about $200 to $10,000. These are available in a variety of forms depending on their purpose. They form the basis of the "home computer" and small business markets, consisting of machines that range in capabilities from television games devices to those large enough for small business accounting, record keeping and word processing tasks. Micro computers can also be used for control and monitoring functions; including on-board

automobile engine tuning, climate control in buildings, cycle machine controllers in manufacturing industries and others.

How They Work

All computers operate in a similar manner and have the same basic structure. The computer and the various attached devices such as printers, visual display units (VDU's) and keyboards, etc., comprise the equipment or "Hardware" to perform various tasks. A computer is simply a machine and as such it cannot think or apply logic to solve problems (at least not yet) as humans do.

To perform even the simplest task the computer requires a set of precise instructions called a programme. Programmes are often referred to as "Software".

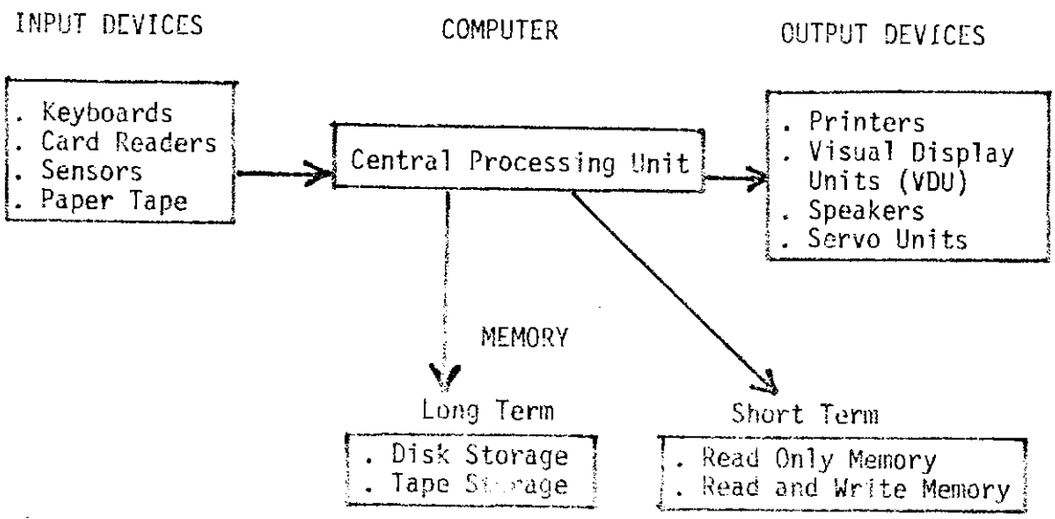
Special languages have been developed to enable programmes to be written in a way that can be easily understood by both the programmer and the computer. Some languages, however, are better suited for specific programming tasks than others. For example, most accounting programmes are written in Cobal language, scientific programmes are often written in Fortran IV and the computer games programmes are generally written in Basic. Another very flexible language is Pascal.

Each computer has a "language compiler" that translates the programming language into "machine language". Because the computer is an electronic machine it interprets each character (number, letter or punctuation mark) as a coded sequence of electrical impulses - something like morse code.

Parts of a Computer

Computers are made up of several distinctive parts as shown in the diagram below:

Parts of a Computer and Accessories



. *The Central Processing Unit*

The Central Processing Unit (CPU) is the "electronic brain" of the machine. It receives information, processes it according to its instructions and sends the results to output devices and/or memory.

. *Memory*

The ROM (Read only Memory) is where specific operating instructions for the CPU are permanently held. ROM controls the machine whenever it is operating. The RAM (Read and Write Memory) is the area that receives the programme instructions and the data which is to be computed and/or stored.

. *Input Devices*

These provide the means of entering data into the machine. The keyboard terminal, set out like a typewriter with the addition of a few control keys, is the most common means today of entering new programmes and data. Card readers and paper tape readers were in common use on early machines but have given way to the keyboard terminals.

Various types of sensors may be used where a computer is to control and monitor equipment operation. Examples include electronic temperature, light, speed, distance, time, fluid level and moisture sensors.

. *Output Devices*

Both visual display units (VDU) and printers are used to obtain information. Either or both of these devices can be used to see what information is entered to the computer as well as that provided by it. Ideally the VDU is used for interactive communications (displaying questions and answers between man and computer), and the Printer is used to obtain permanent records of results generated.

Speakers are often used to provide audio prompting when communicating with the computer via a terminal. In some applications synthetic voice messages are programmed onto a silicon chip to provide specific audio responses.

Where computers are monitoring and controlling equipment, servo units are used to tranlate electronic signals into mechanical action for operating valves and switches, etc.

Could A Computer Help You In Your Work

The most common use for computers is for data processing. Some such jobs, however, are better handled by manual calculation with the aid of a small calculator.

Before considering using a computer check your existing manual system and revise it where possible. Streamlining your current manual system may in fact solve all your problems.

Computers are useful tools for processing data if you have;

1. *Many repetitive tasks,*
2. *and/or extensive analysis of the same data.*

Using a computer won't generally result in any direct time savings. However, many indirect savings can be expected since more thorough data analysis, etc., can usually be done - providing you with more useful information.

Selecting A Computer System

If you have decided that you need to use a computer then I suggest that you follow these steps:

1) Identify the Task(s)

2) Select suitable Programme(s) to perform the task

3) Select a computer that will run the programme(s).

If you already have access to computing equipment obviously you should try and find programmes that will both do what you want and will operate on existing equipment. However, the above order of priorities still apply and it may still be preferable to run your programmes on another computer.

When selecting a programme, examine as many apparently suitable programmes as possible before making a choice. If there is no readily available software to suit you, you could have to get a programmer to write one. This, however, can be a very expensive option. There are many general purpose programmes available for tasks such as filing and accessing data (data base programmes) and financial planning. These can be 'personalised' to suit your requirements for a nominal cost.

Remote Sensing - A Tool in Weed Management

By Keith R. McCloy,
Principal Officer (Remote Sensing),
N.S.W. Department of Agriculture.

Introduction

Remote sensing is defined as the acquisition of data about an object or surface using a remotely located sensing device, and the extraction of information on that object or surface from that data. A system that fits within this definition consists of the eye and the brain where the eye receives the data which is then transmitted to the brain where it is processed into information. In practice the definition is constrained by insisting that the remotely located sensor be man made, like a camera or scanner.

To look at the usefullness of Remote Sensing in Weed Management requires analysis of the characteristics of remote sensing in relation to weeds, and the management practices involved in their control.

This paper will review the characteristics of remote sensing and attempt to describe how it may interface with weed management practices.

Discrimination of Noxious Weeds

The energy incident on a camera or scanner is dependent upon the energy output from the sun, atmospheric conditions and the reflectance properties of the surface. Atmospheric conditions will only change slowly across an area or image so that rapid changes in tone or colour in an image are due to rapid changes in the energy incident on the sensor that are caused by changes in reflectance at the surface.

Crucial to remote sensing is the concept of unique spectral reflectance characteristics of different surface types.

Typical spectral reflectance curves for green and brown vegetation, water and soil are given in Diagram 1. Clearly the more different the spectral reflectance, the more easily the surfaces can be discriminated.

With weeds, they will reflect in a similar way to other types of vegetation at some stages during their growth cycle, and may reflect quite differently at other stages. We need detailed spectral reflectance data of all noxious weeds, and of all likely confusion crops, so as to determine;

(i) which wavebands will optimise discrimination.

(ii) at what stage during the year or season should the imagery be acquired.

(iii) the reliability of the discrimination.

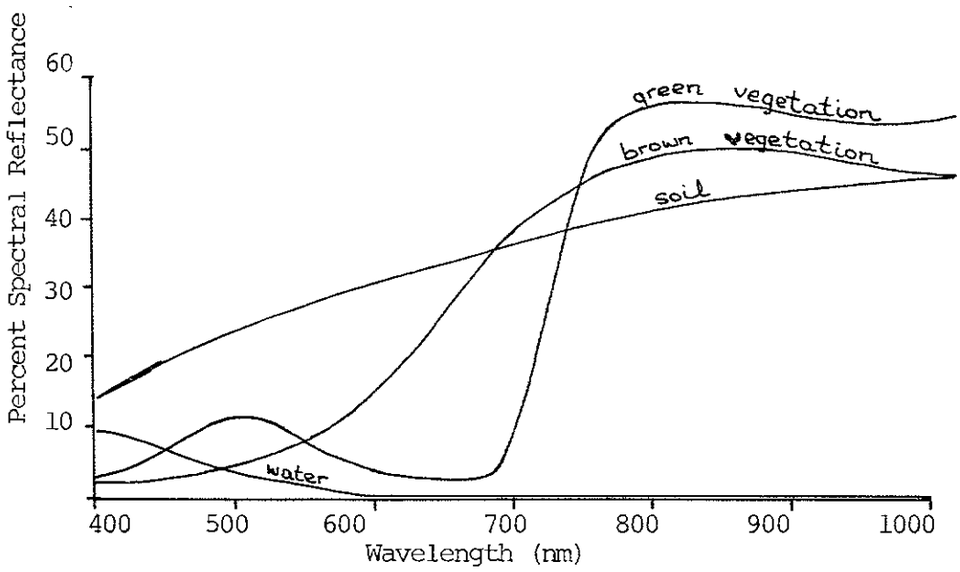


Diagram 1: Typical Spectral Reflectance Curves for Soils, Water and Green and Brown Herbage.

The spectral reflectance properties of a plant are dependant upon the spectral reflectance properties of the individual plant elements as well as their position, and orientation in the canopy. Thus a plant under stress, with wilted leaves, will reflect differently than will a healthy plant, if only because of the change in the plant geometry.

If the vegetative canopy is changed, say by winds bending the plant stems, then this will be accompanied by a change in reflectance.

Clearly weeds are most likely to be discriminated from other types of vegetation either at some stage in their growth cycle when they have unique reflectance attributes, such as flowering, or if their growth cycle is significantly different to all other canopies, and can be monitored using sequential imagery.

Satellite Systems

There are currently three satellite systems that might be of interest. They all use scanner acquisition systems that sense the radiation from finite rectangular elements constructed as a grid over the whole image area. These elements are known as picture elements or pixels.

Each pixel is sensed in a number of wavebands and the input radiance is converted into a number in a range o to n. n is the maximum value and indicates the resolution of the data within the band.

Landsat MSS		Landsat TM		SPOT	
Band No.	Waveband	Band	Waveband	Band	Waveband
		1	450-520 nm		
4	500-600 nm	2	520-600 nm	1	500-600 nm
5	600-700 nm	3	630-690 nm	2	600-700 nm
6	700-800 nm	4	760-900 nm	3	800-900 nm
7	800-1100 nm	5	1.55-1.75 nm		
		6	2.08-2.35 nm	Pan	500-700 nm
		7	10.4-12.5 nm		
80 m resolution		30 m resolution		20 m resolution	
				10 m resolution	

Landsat acquires data once every 16 days and SPOT can be pointed to acquire imagery on up to three consecutive days. Landsat MSS data has 64 resolution levels within the bands whereas the TM data has 256 resolution levels. The TM data, with more precisely defined bands, and much greater sensitivity offers the most scope in detecting and monitoring changes in the extent and density of noxious weeds.

Generally noxious weeds will not cover the whole of a picture element or pixel. In this case the pixel contains two or more surface types and the resultant reflectance of the pixel is a summation of the contribution by the two or more surfaces according to the equation:-

$$Reflectance = A_1.R_1 + A_2.R_2 + A_3.R_3 + \ldots.$$

Where Ri = reflectance of suface i

Ai = proportion of pixel area covered by surface i.

Pixels of this type are known as mixed pixels. Techniques have been developed to identify the proportions, Ai of the different surfaces contained within a mixed pixel in circumstances where the reflectance properties of all the parent surfaces, Ri are known. Whilst the accuracy of discrimination depends upon how different are the reflectance properties of the parent surfaces, if they are significantly different then proportions Ai can be estimated better than 10%.

This concept of processing the satellite data as if all pixels are mixtures of a number of different surface types is likely to be one of the most valuable ways of extracting information on weed populations.

The Use of Remote Sensing in Weed Management

Weed Management involves two activities in which remote sensing can help. The first activity is to identify the location and extent of the weeds, or weed mapping. Macro-scale remote sensing techniques are of use here. How to exploit those techniques will depend upon the reflectance characteristics of the weeds in relationship to all other land covers, throughout the weeds growth cycle. Thus it may be possible to discriminate at one date, or multidate imagery may be necessary. It is possible that the differences in reflectance between landcovers are subtle in which case the changes in reflectance over time may give better discrimination between the landcovers.

In all cases of weed mapping it will be necessary to computer process the digital data either to produce enhanced imagery to create the maximum discriminability between the weeds and other lands covers or to transform the data, such as by mixed pixel processing, prior to enhancement.

The second activity concerns control. In this situation remote sensing technology could be used to discriminate weeds from other surfaces by use of detectors located near the sprays. The detectors would feed the

response into a micro-chip which would make the decision on whether the surface sensed is weeds or not. If the decision is weeds then an instruction would be sent to turn on the spray. In this way the amount of spray used can be significantly reduced, being of economic benefit to the farmer, and of environmental benefit to the whole of society.

Summary

Remote sensing offers some potential in locating and determining both the extent and rate of spread of noxious weeds. This is important in assigning priorities and preparing control programmes. It offers even more promise for monitoring changes in known infestation both before and after treatment, and may assist in reducing costs in spraying.

Allelopathy and Self Defence in Weeds

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Introduction

"The presence of a plant changes the environment of its neighbours and may alter their growth rate and form. Such changes in the environment, brought about by the proximity of individuals, may be called 'interference' ...." Harper (1977).

Weeds usually interfere effectively with the plants which agriculturalists consider most useful. Interference includes the more commonly recognised "competition" - usually for water, light or nutrients; climatic modification by one plant which may affect another; plants acting as alternate or alternative hosts to pests or diseases which then attack a neighbour, and allelopathy.

Allelopathy and allelochemicals

The term "allelopathy" derives from Greek words which mean, literally, "mutual harm". However, allelopathy is not necessarily harmful and Molisch (1937) uses the term to describe all biochemical interactions, whether positive or negative, among plants of all levels of complexity, including microorganisms.

More than 10 000 organic compounds of low molecular weight are known to exist in plants (Swain, 1977). They have been termed 'secondary compounds' by Levin (1976) because they are produced as byproducts of primary metabolic pathways. Some are associated with particular families of plants, for example, the glucosinolates with the Cruciferæ. Others, like the alkaloids, are more cosmopolitan. Swain (1977) considers that the function of such secondary compounds is as chemical signals in ecosystems and there are documented examples of the significance of such chemicals in communication between plants and other organisms, including the performance of defensive and even offensive functions for the plant which produces them. Many of the defences of plants against insect attack are chemically based (Maxwell, Jenkins and Parrott, 1972) and Levin (1976) discusses resistance to fungi,

bacteria, viruses and nematodes which may also be based upon the presence of secondary compounds, particularly the phenolics. Curiously, the allelopathic role of such chemicals is the least well understood but it is accepted that they often function in defence of the plant which produces them.

Occurrence of allelochemicals

Allelochemicals, secondary chemical compounds, are a normal part of the plant's make up and may occur, so far as is known, in all higher plants.

In natural plant communities, allelochemicals are part of the checks and balances that maintain relative stability. Many responses to allelochemicals are therefore subtle, having developed during evolution of the community. Whittaker (1970) states that '... the known examples of allelopathic effects are only the most conspicuous cases, which have been observed because they stand out from a matrix of more general and less obvious influences.'

In agriculture, where checks and balances are often missing, the role of allelochemicals is less well understood. Their effects are sometimes dramatic but may be difficult to distinguish within the climate/soil plant complex. Lovett and Levitt (1981) discuss evidence which indicates that the allelopathic potential of many crop species may have been reduced relative to that of weed members of the same family, as a result of the concentration of plant breeding efforts on other objectives. For example, whilst Rice (1974) discusses evidence for allelopathic activity of several species of weed-type sunflower, our work (Lovett, Fraser and Duffield, 1982) has shown that such activity appears to occur only at a very low incidence in cultivated sunflower.

Release of allelochemicals

Allelochemicals may be produced by any part of the plant, including the pollen, although leaves and roots are the main sources (Horsley, 1977). The effects of allelochemicals are related to their concentrations which, in turn, are related to the manner in which allelochemicals are obtained from plant tissues.

In our work, decomposing foliage of weeds such as 'Sorghum alumum' (L.) Pers. (Gramineæ), 'Stevia eupatoria' Willd. (asteraceæ), 'Salvia reflexa' Hornem (Labiatæ) , 'Datura stramonium' L. (Solanaceæ) and 'Camelina sativa' L. Crantz (Cruciferæ), has been found to produce inhibitors of crop plant growth and/or development, whereas washings of live foliage of the same species often produce mild stimulation, of for example, radicle elongation in phytometer species. With the widespread acceptance of techniques such as minimal cultivation, plant residues may remain unincorporated on soil surfaces for considerable lengths of time so that allelochemicals from dead and decaying plant residues may enter and accumulate in the soil. Such accumulation has been shown to occur in natural plant communities by Muller (1966). A similar accumulation may occur as a consequence of repeated fog, dew or rain-washing of allelochemicals from living plants. Thus, while at a given point in time relatively low concentrations of allelochemicals may be liberated to the environment, this concentration may move, through accumulation, from stimulatory to inhibitory levels.

Transfer of allelochemicals

Water is critical to the release and transfer of allelochemicals. In the work of Grummer and Beyer (1960) natural or artificial rainfall was necessary for foliar transfer of allelochemicals, which are often washed from the surfaces of foliage or leached from foliage. Water may also be necessary for the release of concentrations of allelochemicals from specialized structures such as glandular hairs (trichomes) in which they have been stored .

Examples of allelopathy

a) Pasture weeds

Pasture plants remain relatively neglected in studies of allelopathy. However, weeds of pastures have commanded some attention. Allelopathy, resulting from chemicals produced by wireweed ('Polygonum aviculare' agg., Polygonaceæ) has been implicated in reduced germination of annual medics in South Australia by Kloot and Boyce (1982). These workers, like Muller (1966), conclude that interference with cell division during early growth is the probable primary mode of action of the allelochemicals concerned.

In studies of Kempton's weed ('Stevia eupatoria', Asteraceæ) on the Northern Tablelands of New South Wales allelopathy has been identified as a factor affecting interference of the weed with 'Trifolium repens'. Recent data, Table 1, show that germinating seedlings of 'Trifolium repens' are affected by Stevia allelochemicals within 24 hours of application. Effects such as these on germination and early growth have long term implications for the success even of the surviving plants.

Table 1. Effects of leachates of Kempton's weed plant parts on germination and early growth of white clover

	Germination (x/25)			Radicle length
Hours from sowing	24	48	72	(mm)
Control	6.80 a	16.00 a	17.00 a	15.29
Leaves	0 b	0.20 b	1.20 b	3.5 b
Stems	1.00 b	2.40 c	4.20 c	8.1 c
Flowers	0.60 b	2.60 c	4.00 c	6.0 bc

Means which share a common letter are not significantly different at the 5% level, Studentized Range Test.

It is interesting that these examples both tend to confirm that, in the pasture situation, legumes appear to be susceptible to allelochemicals.

b) Crop weeds

(i) Mintweed and wheat.

The production of volatile growth inhibitors by aromatic shrubs has been investigated in detail. In particular, 'Salvia leucophylla' Greene, 'S. apiana' Jeps and 'S. mellifera' Greene (Labiatæ), which grow naturally in the soft chaparral of Southern California, contain phytotoxic terpenes which volatilize and inhibit the establishment of seedlings of a wide variety of plants (Muller, 1966). The zone of inhibition may extend 8 - 10 m beyond either the lateral spread of the 'Salvia' root system or the shrub crown, favouring the hypothesis that the toxic material released by these 'Salvia' plants is volatile.

Bioassay techniques confirmed that 'S. leucophylla' leaves were the site of production of phytotoxic terpenes. Gas chromatographic analysis revealed the presence of α-pinene, β-pinene, camphene, cineole and camphor, all of which inhibited the germination and radicle growth of phytometer species. It was shown that the soil, particularly when dry, acted as a reservoir for the terpenes, accounting for inhibitory effects observed in the field.

Experiments with mintweed ('S. reflexa' Hornem), a significant weed of cropping areas in north-western New South Wales and south-eastern Queensland, showed that aromatic substances liberated by whole plants slightly stimulated early growth of wheat. Wetting the foliage greatly enhanced the scent of mintweed, a phenomenon noted by Muller (1966) in his work with aromatic species.

Recent analyses have confirmed the presence of cineole and β-pinene in washings of mintweed foliage. Confirmation of the presence of α-pinene is awaited. Such washings are severe in their effects upon germinating wheat, Table 2.

Table 2. Effect of leaf washings of mintweed on germination and early growth of wheat

		Days after sowing					
		5	6	7	8	9	10
Emergence	Sterile water (control)	42.5	70.0	77.5	80.0	82.5	87.5
	'Salvia' washings	20.0	32.5	45.0	47.5	50.0	50.0
	P	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01
Height of coleoptile (mm)	Sterile water (control)	20.8	29.5	54.8	81.8	102.0	111.7
	'Salvia' washings	9.5	18.7	35.1	66.3	86.0	108.1
	P	<0.01	<0.001	<0.05	N.S.	N.S.	N.S.

(ii) Thornapple and sunflower

Thornapple ('Datura stramonium' L., Solanaceæ) an erect summer-growing annual, is an important weed of many irrigated summer crops (Felton, 1979). In common with many of the Solanaceæ, thornapple contains alkaloids, principally scopolamine and hyoscyamine, which are translocated from the site of synthesis in the roots to accumulate in the leaves and seeds.

The alkaloids of thornapple have a certain protective function in that they make the plant taste bitter and hence unpalatable to stock. Lovett, Levitt, Duffield and Smith (1981) established that aqueous leachates of thornapple seeds and leaves contained scopolamine and hyoscyamine, seed leachates having a significantly higher concentration of total alkaloid than leaf leachates. The application of various concentrations of leachate and alkaloid solutions to seeds of a phytometer species linseed ('Linum usitatissimum' L.) on sterile filter paper indicated that both alkaloids were major active principles in the depression of germination and radicle elongation.

One thornapple plant may produce up to 24 000 seeds in a season with each seed capsule containing about 250 - 700 seeds. These fall to the ground below the parent plant, providing a high concentration of alkaloid-containing material in the soil.

Dormancy is an important factor in dispersal in time of many weed species. In thornapple, dormancy is broken when alkaloids are leached from the seed coat. Rain is vital to this process and is known also to remove significant quantities of alkaloid from leaves of thornapple. Crop seeds adjacent to thornapple seeds in the soil will, therefore, be exposed to varying amounts of alkaloids which are resistant both to leaching from the profile and to bacterial degradation.

Observations by Winter (1961) suggested that plants take up alkaloids from the soil by processes similar to those involved in nutrient uptake. Thus, soil factors which influence plant nutrient uptake (such as particle size, and clay and organic matter contents) may also influence the uptake of alkaloids. Data resulting from the application of thornapple seed leachate

and a 0.5 per cent scopolamine solution to sunflower ('Helianthus annuus L.') seeds sown either in sterile coarse sand or in a sterile 4:1 mixture of soil and peat are present in Table 3.

Table 3. Effect of thornapple seeds, seed leachate and a 0.5% scopolamine solution on sunflower radicle elongation in two media

	Sunflower radicle length after 72 h (mm)				
Medium	50 mL sterile water	50 mL sterile water + 550 D. stramonium seeds	50 mL 0.5% scopolamine solution	50 mL sterile water + 550 D. stramonium seeds	P
Sterile coarse sand	50.3 a	34.6 b	29.4 bc	25.9 c	<0.001
Sterile 4:1 soil + peat	53.2 g	40.6 h	38.8 h	15.1 i	<0.001

Means which share a common letter are not significantly different at the 5% level, Studentized Range Test

In either medium the response of sunflower to the various treatments was similar, however, the seed leachate treatment produced a greater inhibition of sunflower radicle elongation in the soil and peat medium than in the coarse sand medium. This indicates that the sunflower seedlings may be taking up more alkaloid at relatively high concentration in the former medium, possibly because of the greater contact provided between soil and seed.

Further experimentation has shown that, in soil under field conditions, allelochemicals from thornapple seed retain phytotoxic activity for over fifteen weeks (Table 4).

Table 4. Effect of time on the ingibition of sunflower radicle growth by seeds of thornapple: 20 weeks under field conditions.

	Sunflower radicle length (mm) means of 80				
Time (weeks)	0	5	10	15	20
Control	80.2	61.9	68.3	52.9	51.2
Thornapple seeds	66.9	48.9	55.9	41.3	51.6
5% LSD	6.87	7.75	6.16	7.03	7.07

This is significant in terms of summer/winter crop rotations and suggests that there may be an allelopathic component involved in interference between thornapple and summer crops such as sunflower, as well as the factors of competition for light, moisture and nutrients which are cited in the literature.

If alkaloids in a weed such as thornapple can complement competitive ability with a crop, the reverse may be possible for an alkaloid-containing crop plant. It is, for example, a relatively simple genetic procedure to increase the absolute amounts of alkaloids produced by tobacco ('Nicotiana tabacum' L.), and this applies to most commercially important Solanaceous species. Any benefit in terms of weed control resulting from such genetic manipulation must, however, be weighed against possible detrimental effects to the commercial value of the crop.

The potential value of allelochemicals

It has been estimated by a number of authorities (for example, Russell,1978) that as much as 50 per cent of the yield potential of crop species is sacrificed annually to the depredations of weeds, insects and diseases. In the past half-century the agriculturalist has come to rely increasingly upon synthetic chemicals to offset these losses, but they continue relatively unabated.

If allelochemicals can be harnessed to the advantage of crop plants, it would be reasonable to expect both direct benefits, in terms of reduced dependence upon herbicides, and indirect benefits resulting from the alleviation of stress by interference from weeds.

As emphasized by Whittaker (1970), chemical defence of plants is relative and very seldom complete, however, it may be sufficient to reduce stress to the point where a crop is less vulnerable to pest, disease or weed influence, thereby reducing or even eliminating the need for pesticide applications. With regard to weeds, it is now widely accepted that cosmetic ('total kill') weed control is both unattainable and undesirable. Management of weeds at tolerable levels by manipulation of natural crop defences is a logical corollary of this acceptance.

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Blackberry in New South Wales, 1982

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Blackberry is not only a problem of pasture areas but can be an important weed in parklands, recreation areas, industrial sites and home gardens. Blackberry is proclaimed a noxious weed in N.S.W. Growing mainly in coastal, tablelands and slopes and in parts of the northern plains area.

Increasing pressure from opponents of 2,4,5-T use have made it necessary to test the effectiveness of other herbicides. Several new herbicides have been registered in 1980/81 for use in blackberry control.

It is apparent from the estimated areas of infestation and of Council and private expenditure that the area of land infested by blackberry is still very large despite the effort directed at blackberry control over the last thirty years using the herbicides available. Therefore greater co-operation between Governments, Department of Agriculture, Councils and the rural community will be vital if a substantial reduction in infested areas is to be achieved.

A survey was carried out by N.S.W. Department of Agriculture Field Officers (Weeds) in association with Councils during 1980 to estimate the area, density (Table 1) and annual expenditure (Table II) for blackberry in N.S.W.

Total estimated expenditure on blackberry control for N.S.W. in 1980 was almost five million dollars, however the cost of herbicides registered for use since 1980 is significantly higher than 2,4,5-T which has been widely used for many years. If the expenditure estimated in 1980 (Table II) was based mainly on the cost of this commonly used herbicide, then the overall cost of control using the new herbicides would be considerably more. The cost of using the next cheapest herbicide would in excess of twenty million dollars if the same areas were sprayed for blackberry control as in 1980.

The need for access to these more expensive herbicides at contract or wholesale rates will be desirable if a satisfactory level of blackberry control is to be continued, particularly by Councils who are experiencing increasing pressure from outside forces in the use of the traditional and cheapest herbicide.

Blackberry control trials have been conducted by the Weed Research and Demonstration Unit based at the Agricultural Research and Veterinary Centre, Orange during the years 1979/80/81. A summary of these trials are in Table III.

It is essential that trials for blackberry control demonstrating new and experimental herbicides together with new techniques to be carried out in the future. Co-operation between chemical companies, council weeds officers, Department of Agriculture personnel and land owners will ensure the success of these trials.

See Tables on following page

Table I. Estimated areas and densities of blackberry in New South Wales, 1980.

Agricultural region	Dense infestation (ha)	Medium infestation (ha)	Sparse infestation (ha)
1. Mid Coast and Hunter Valley	15,000	10,400	50,900
2. North Coast	300	800	3,100
3. New England	25,350	420,000	1,987,500
4. Western	8,200	200	200
5. South Western		insignificant	
6. Southern	63,800	186,800	382,200
7. South Eastern and Illawarra	3,400	41,500	139,400
8. Central Western	55,200	175,400	407,000
	171,250	835,100	2,970,300

Table II. Estimate expenditure on blackberry control in New South Wales, 1980.

Agricultural region	Council expenditure ($)	Landholder expenditure ($)	Total expenditure ($)
1. Mid Coast and Hunter Valley	105,200	122,300	227,500
2. North Coast	10,900	33,100	44,000
3. New England	215,000	2,672,100	2,887,100
4. Western	16,000	11,500	27,500
5. South Western		insignificant	
6. Southern	53,000	530,900	583,900
7. South Eastern and Illawarra	88,000	261,000	349,000
8. Central Western	68,100	755,300	823,400
	556,200	4,386,200	4,942,400

Table III. Weed Research and Demonstration Unit trials for Cadia, 1979, Cargo, 1980 and Cadia, 1981.

Herbicide	Rate Product:Water	Mean Percentage Regrowth 1 year after application. Spraying Date 3/3/79	24/1/80	2/2/81	9/3/81	Cost
2,4,5-T##	1:1000	69	55	67	27	1
Amitrole plus##	1:50	14	50	20	4	7
Garlon	1:960	#	32	56	26	-
Garlon	1:640	#	49	70	29	-
Garlon##	1:480	#	41	51	26	4.7
Garlon	1:320	#	20	41	11	-
Garlon	1:240	2	#	40	16	-
Roundup##	1:100	39	#	#	1.7	15
Roundup##	1:75	#	#	1.3	1	20
Roundup	1:50	21	2	1.7	0.6	-
Krenite##	1:100	49	5	#	#	14
Krenite	1:50	#	9	#	#	-
Mixed Esters	1:166	43	#	#	#	2.5
Tordon 50-D##	1:50	#	4	#	#	22
Tordon 520##	1:200	16	#	#	#	6

NOTE:

 # Not applied in these trials.

Registered herbicides.

Comments: (i) *Relative costs compared with 2,4,5-T at $1.20 per 100 litres of water.*

(ii) *Tordon 520 registered for use at 1 L per 100 litres of water.*

(iii) *Mixed esters 2,4-D 20% plus 2,4,5-T 20%.*

History

Blackberry was introduced into Australia by early settlers from Britain. Details of some early recordings are from the Bathurst Free Press, 1st February, 1851, which claims blackberry had been planted in the Bathurst area in the late 1830's and from the Sydney Morning Herald, 11th January, 1851, which recorded blackberry growing in a garden in Sydney (Bayley, 1962).

There are at least eight separate types of blackberry in Australia and some hybridization occurs between types.

Habitat

In Australia blackberry grows mainly in areas where the annual rainfall is greater than 760 mm but in drier areas it often grows along creek banks, irrigation channels and in townships (Amor and Richardson, 1980).

Perennation

The root system is perennial and the canes live for 2-3 years. New canes are formed in spring from buds on the crown and occasionally from the roots, particularly after herbicide treatment. Daughter plants are formed in spring at the apices of the canes which have tip rooted in the autumn (Amor and Richardson, 1980).

Seeding Growth

Babington (1869) described the development of blackberry seedlings under English conditions. In the first summer two cotyledons and a cluster of simple leaves are produced. In the second summer short slender shoots which bear compound leaves are formed. In the third summer the shoots bear small panicles and larger shoots are produced from the roots. Extensive flowering occurs in the fourth summer (Amor and Richardson, 1980).

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Using Pastures for Roadside Weed Control on the Coast

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Department of Agriculture.

Precis

The use of competing pasture plants is a very cheap and effective method of weed control. Probably the best example is the smothering habit of kikuyu used to combat bracken on the north coast.

Choosing a Pasture Plant

Perennial grasses should be used in preference to annual grasses and legumes, since they are more competitive and often require less management. They also make better use of soil nitrogen provided by any associated clovers in the pasture.

Other points to consider:

1. Relative growth seasons of the pasture and the weed to be controlled
2. Ability of the pasture plants to spread and to provide ground cover
3. Likely weed potential of the pasture plant
4. Establishment of the pasture
5. Growth habit of the pasture
6. Cost and availability of pasture seed and/or planting material.

Management

The pasture has to be able to persist with little or no management.

During the establishment phase, summer growing grasses can be encouraged to spread by topdressing with nitrogen at 30 to 40 kg per ha. Maximum response to nitrogen occurs from topdressing in early spring and early autumn.

Most grasses can be managed by slashing or burning. The summer growth should be kept slashed around guide posts, etc., and the body of dry grass burned in late winter to promote new growth in spring.

Which Grass?

Kikuyu, Rhodes grass and Setaria are excellent grasses for weed control.

Seed of Kikuyu and Setaria is expensive and should be sown into a prepared seed bed for best establishment.

Rhodes grass seed is much cheaper, and can be sown in rough seedbeds with reasonable success.

Two species of 'Digitaria', Pangola grass and Swazi grass, are also possibilities. However, Pangola grass can only be established from vegetative material, whil Swazi grass can be planted using either seed or cuttings.

Native Species

In certain situations, native species can supply good ground cover and restrict weeds. Blady grass is an example, and should be retained in this role in those situations rather than be replaced by another grass.

Using Pastures for Roadside Weed Control in Inland N.S.W.

By Warren McDonald,
Pasture Specialist,
Department of Agriculture.

"Destroy the weed but replace with a seed" has long been the catch-cry of weed control technologists. Rarely though is this philosophy practised in the area of noxious weed control on roadsides.

It is not uncommon in many overseas countries to replace weeds on roadsides with desireable species and in some instances go one step further and farm these areas to return a profit for the organisation concerned.

Much of the work in developing roadside vegetation areas, has been aimed at stabilising newly constructed areas to reduce the erosion risk as well as providing an acceptable type of vegetation, which does not pose any threat, and one which adds beauty to the surrounds. (Californian poppies for example are used widely in California for this purpose as is Crownvetch in Pennsylvania).

In Australia more attention has been given to using recognised pasture and crop plants, with varying degrees of success. The Soil Conservation Service has had considerable success in stabilizing roadside areas with pasture and crop species using the hydromulch principle - a slurry made up of seed, fertilizer and pine fragments.

In more extensive areas we are looking at a method that is relatively permanent and cost effective. In the dry and relatively unreliable inland areas of N.S.W. this is difficult to achieve, however there are many situations where roadside weed vegetation can be converted to pasture, effectively.

The payoff to the organisations concerned can be considerable. The long term cost of weed control can be reduced as can the spread of weeds and erosion. The countryside can be converted into a more aesthetically pleasing environment at the same time.

On the debit side, pastures can be costly to establish and maintain depending on the situation. Costs presently range from around $30/ha for a simple surface sown sub clover based pasture with fertilizer to $150/ha for a perennial grass pasture established into difficult country using herbicides. Obviously each situation has to be examined individually and assess as to the cost/benefit analysis and the likelihood of successful establishment and persistance.

Three aspects have to be considered when assessing if pastures can play a role in a particular situation - suitable species, reliable establishment and post sowing management.

Species

In assessing the species possibilities the following points should be examined:-

* *The species must be well adapted to the environment once established.*
* *It must be capable of good regeneration by seed, vegetative means or both.*
* *In most roadside situations, species with low seeding vigour will not survive.*
* *Competitive ability - the requirement will depend on the target weed spectrum.*
* *The introduced species must not pose any economic threat to adjoining lands or to areas to which it may spread.*

It is also desirable that the species sown be short in stature and aesthetically pleasing.

The growth pattern is not particularly important except from the erosion control and aesthetic aspect, it is important that the plant survives and thrives in the environment.

Inclusion of a legume is of course desireable.

Sowing Systems

There is no doubt that the conventional system of sowing, that is, to prepare a suitable seedbed by cultivation following and sowing with a machinery such as a combine is the most reliable method. However alternative systems, when used correctly are capable of producing comparative results.

In most roadside situations, however, using systems that cause less disturbance to the surface such as direct drilling (sowing directly into the existing vegetation) or surface sowing (aerial) generally increase the risk of failure, particularly to the west of the reliable tablelands country. Direct drilling or surface sowing may be the only practical method to sow pastures on roadsides.

Points to consider when using direct drilling or surface sowing into roadside situations are:-

a) *Competition control is the key to successful establishment. The degree of competition control needed is dependant on the weeds to be controlled, the species to be sown, sowing time, and moisture and nutrient availability. In most situations the greater the control of competition in the seedbed, the better the establishment. Herbicides can be used effectively for this purpose. Manipulation of grazing pressure, sowing time, etc. can be used to advantage instead of using herbicides in some situations.*

b) *Use pasture species with high seedling vigour.*

c) *The sowing time available is much narrower than that of conventional sowing. There is no fallow storage of soil moisture in the conventional sense, so that sowing can be delayed increasing the risk of failure.*

d) *Pest control is of greater significance when direct drilling or surface sowing. Seed may need to be treated against seed harvesting ants and young seedlings protected from insects such as earthmites and scarabs.*

e) *Fertilizer requirement may be greater with direct drilling or surface sowing.*

f) When direct drilling, use machinery that suits the purpose. There is a wide range of machinery types available. Robust chisel machines are the most likely machine to succeed over a wide range of conditions. Machines should be capable of sowing the seed shallow, close to the fertilizer, with minimum disturbance and with minimum coverage of clods.

Post Sowing Management

The degree to which time and effort will be needed following the sowing operation is very much dependent on the situation.

It is imperative that the job is not considered finished when the machine or aircraft leave the area. The success of many commercial sowings has been very much dependent on action taken following sowing. Insect and weed control are the two major concerns.

Where a new species has been introduced to outcompete an undesireable weed, the process is inevitably a slow process. Assistance by way of pesticide use or manipulation of grazing pressure where practical can hasten this process and in some cases prevent the new sowing from being lost.

In summary, there is considerable potential to use pastures for roadside control of noxious weeds in inland N.S.W. however the limitations of climate, species availability and cost, indicate that every situation has to be assessed individually as to the cost and benefits likely to be involved.

Further Reading

1) "Direct Drilling of Pastures", N.S.W. Department of Agriculture Agfact, 1983.

2) Aerial Techniques for Pasture Improvement Bull., No. 131, N.S.W. Department of Agriculture.

Control of Tiger Pear - When is this Weed under Control?

By J. R. Hosking,
Agricultural Research Centre,
Tamworth.

The Prickly Pear Destruction Commission has mainly relied on herbicides to control tiger pear, 'Opuntia aurantiaca', because biological control using insects has failed to give uniform results. Over the last five years, however, the increased costs of herbicides and labour has led to a re-examination of the use of insects, particularly cochineal ('Dactylopius austrinus'), for the control of tiger pear.

Recent research has defined conditions suited to cochineal control of tiger pear. The dry conditions prevailing throughout most of New South Wales from late 1979 to November 1982 have been particularly suited to cochineal development and generally not suited to cactus growth. Cochineal spread by the Commission during this period has caused a large decrease in the quantity of tiger pear. However, tiger pear cannot be eradicated by biological control. Chemical control also usually fails to eradicate tiger pear because of the cost involved with a number of treatments and the inability of spot spray operators to locate all plants. For this reason I believe that we have to learn to differentiate between a weed which needs control and one which is present, but does not require treatment.

Weeds may be divided into the following groups on the basis of where they occur or why they are a problem.

(1) weeds of wasteplaces e.g. roadsides

(2) weeds of crops

(3) pasture weeds, which may be subdivided into weeds of

  (i) lawns

  (ii) planted pastures

  (iii) native pastures

(4) weeds of forests

(5) weeds which compete with native flora

(6) weeds of recreational areas

The need for weed control will depend on where the weed occurs and how rapidly it will spread.

Using tiger pear as an example, it is often a weed of waste places, is no problem in crops where cultivation is carried out (plants are destroyed by ploughing), is mainly a problem of native pastures, a minor problem in forests (mainly to humans using this area), competes with native flora and is definitely a hazard to recreation. Placing values on each of these problems is difficult. For example, there is close to zero tiger pear tolerance close to households with young children or close to camping areas. However, scattered plants over many thousands of hectares of grazing land should probably be tolerated. Treatments aimed at reducing low levels of tiger pear infestation usually cost more than potential benefits.

Tiger pear can spread rapidly, or slowly, depending on plant location and weather conditions. This plant grows from segments and not from seed. The main means of spread is by floodwaters as segments float readily. Animals also spread segments as these are easily detached from plants and carried by passing animals to new areas. Water can spread tiger pear over long distances while animal spread is generally only short range. This means that a higher degree of control should be attempted near watercourses compared with other areas.

When considering whether or not to treat an area, one should first determine what level of control is being aimed at and whether this level is realistic. Herbicide treatment of tiger pear in steep rocky areas of low pasture production, or areas of thick scrub, is generally not warranted. The expense of treating such areas will often be greater than the value of the land. Without follow-up treatments, those tiger pear segments missed will grow into new plants covering the same area, within as little as three years. In many areas the cost of regular treatments can never be recovered through increased production. Such treatments have been carried out in the past and probably will be in the future, until people

aim for weed control rather than eradication. Areas such as these can only be treated using biological control, or not treated at all. Untreated areas can be fenced in and abandoned while treating any weeds which spread beyond the fence, or still used without weed control.

Tiger pear can be controlled by cochineal. Field and laboratory studies show that cochineal populations build up most rapidly at temperatures close to 30°C. Dry conditions also aid in tiger pear control by cochineal. Under these conditions plants cannot withstand cochineal feeding for long; and insects are less liable to damage by rain. Cochineal does not seem to control tiger pear under hot wet conditions. Whether this is due to reduction in cochineal populations and/or increased tiger pear growth requires further study. However, as cochineal controls tiger pear in hot dry periods, cochineal insects should be established in all areas so that they can take advantage of the next favourable period. In many areas there is no other economically feasible alternative.

Other biological control agents may be investigated and introduced to increase the level of tiger pear control, particularly under wet conditions. Such conditions are generally suited to plant pathogens which have not been investigated for tiger pear control.

Although this paper deals with tiger pear, similar questions regarding control must be asked about other types of cacti and many other weeds.

Those responsible for weed control shoud be able to advise or know when control work is necessary and when a low level of weeds is permissible. In the past there has been too much emphasis on removing the last weed in a particular area (e.g. roadside) while there is not the same level of control nearby (e.g. many of the same weed on a farm near this roadside). Without uniform control, areas of low or zero weed populations will be invaded from areas with less control. Future research will have to be aimed at determining a weed's economic threshold. Treatment of weed infestations below this level will not be justified.

From this paper I hope that I have managed to emphasise that weed control requires rational decisions on the part of those responsible for this work. Past decisions on weed control have often been similar to the use of a sledgehammer to kill a fly on a sandwich while there is a dead sheep five metres from the picnic table. Questions which should be asked are: What is the problem? Can it be treated? Is it worth treating? When is the problem tolerable?

Helicopter Control of Blackberries

By R. Nalder,
Chief Noxious Plants Officer,
Cabonne Shire Council.

By 1950 blackberries were intensively established in the high country of the Orange district. The Shire Council has since given high priority to the eradication of blackberries and all plants have been removed from arable and accessable land until it is confined mainly to steep creeks, valleys, gorges and inaccessable rocky hillsides.

Burning of such plants was not very successful. Fixed wing aircraft were not suitable in the rougher country because of the variability of the terrain. The difficulty and high cost of eradication in inaccessable country was a real problem.

It was obvious that helicopters could negotiate difficult terrain and maintain a satisfactory spray height above the plants, but helicopter hire was thought to be too expensive.

A helicopter company from Queensland was working in the area in 1980. This company advised that it would undertake work provided a reasonable amount could be guaranteed. Work was arranged with property owners and "Rotar Spray" from Lismore was hired for blackberry control late in the 1980/81 season. Sufficient work was done to be able to make a reasonable assessment of this new method. I was impressed with the work and arrangements were made for the 1981/82 season.

A small Hillier 12E-E4 type helicopter of 60 gallon capacity was hired from East Coast Helicopter Services (Queensland) and 2,4,5-T ester 80% was mixed 15/1 with water and applied at equivalent of 3 pints of undiluted 2,4,5-T per acre. One full load was treating 10 acres every 20 minutes. Three thousand acres of blackberries were sprayed within 80 km of Orange.

Blayney Air Farmers had hired a Hughs 500D type helicopter from Rotar Spray at Lismore and commenced work in January. This was a larger craft with 120 gallon capacity. 2,4,5-T was again mixed and applied at the same rate except that distillate was substituted for water as the carrier. Five hundred acres of blackberries were sprayed within 60 km of Orange.

The smaller craft appeared to be more manoéuvrable, could fly lower and work in more confined situations than the larger craft and thus obtain better penetration from the down draft and better coverage. The pilot was also more experienced.

Results from both craft were excellent and economical. A large portion of the work was done on infestations of ten acres or less per property. Spot application was easily achieved and group control arrangements were made with up to six property owners in any one area. The craft can land on the banks of dams or creeks for water close to the target. In many cases ground personnel were ferried into inaccessable country to help with filling.

Similar precautions to those necessary for spraying with fixed wing aircraft were necessary for helicopters, but low operating height reduced the drift risk.

We were very conscious of environmental damage and took a number of precautions, namely:-

1. *Target areas were preflown to determine proximity of gardens, crops, orchards, etc. In such cases work was postponed until the autumn.*
2. *Susceptible trees were spotted and a flight plan made to minimise tree damage. Kurrajong trees were lopped when they could not be avoided.*
3. *Spraying was deferred when there were gusty or changeable conditions.*

Despite these precautions it is difficult to spray without some form of damage to trees. Chemical tolerance of tree species needs to be understood and risks appreciated by owners.

Hire charges for both craft were $12.60 per acre plus chemical costs plus distillate when used. Thus with 2,4,5-T being sold at $8.00 per litre the cost of the small craft including chemical was $26.25 per acre. This is very low cost work and is cheaper than ground control, but has the much greater risk of environmental damage and should only be used when risks are low or when a balance is struck between acceptable damage and no other means of access.

Helicopters have therefore been found to be a most useful and economical tool in blackberry eradication.

Note As the helicopter staff worked in imperial units, they have been retained for this paper.

Aerial Application Techniques for Herbicide, Seed and Fertilizer

By M. H. Campbell,
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Orange.

The most important principle in using aerial techniques for the control of weeds is that: all weeds removed must be replaced with better plants. This applies equally to the roadside, the wasteland area, the travelling stock route or the farmer's paddock.

1. Aerial Application of Herbicides

If a weed is to be controlled using aerial techniques it must be replaced by:-

1) sowing better species after spraying, or

2) selective removal of the weed from useful species that replace it once the weed has been killed by the herbicide.

The success of aerial spraying depends on a number of factors, many of which are common to most types of spraying equipment.

1.1 Type of Aircraft Helicopters and fixed winged aircraft can treat most of the differing topographical areas in N.S.W. Helicopters have the advantage where reduced flight speed and greater manoeuvrability is desirable, to increase penetration, and where landing strips are not available. Improved penetration of target species with spray droplets in the strong downwash of the air created by the helicopter rotor is not achieved unless it is flown at less than 25 km/hr, which is usually uneconomical. At operational speeds above 45 km/hr, distribution of spray in the wake of a helicopter is similar to that of a fixed-wing aircraft. As fixed-wing aircraft operate at about 130-160 km/hr, have lower overhead costs, take larger pay-loads and charge less for ferry, they can usually operate more cheaply than a helicopter.

1.2 Spraying Techniques Spraying techniques are often classified, as a matter of convenience, according to the spray volume used:

high volume = >400 L/ha, e.g. spot spraying

low volume = 5 to 400 L/ha, e.g. aerial spraying 15 to 100 L/ha

ultra-low volume = <5 L/ha

The critical factor dividing these categories is droplet size, e.g. ultra-low volume applications generally use a droplet size of 50 microns; higher volume applications use larger droplets.

1.3 Application Equipment The most common spray equipment is the conventional boom fitted to an aircraft with Tee-jet nozzles. The nozzles may be either hollow cone or fan type and spray pressure ranges from 140 to 280 kPa.

1.4 Droplet Size Smaller droplets for a given volume per hectare give better coverage of the target, more penetration of foliage cover, less spray volume per hectare, lower costs, and less stripping than larger droplets. Thus small droplets should be used when applying herbicides that are absorbed by plant leaves and when the aircraft is able to fly low. For good weed control, droplet density should be 20/cm^2 with droplet diameters ranging from 200 microns (one-fifth of a mm) to 1000 microns. Larger droplets would be best used when the herbicide applied enters the plant through the soil and/or the aircraft is flown in hill country.

Droplet size can be varied by using different sized nozzles, speed, pump pressures and nozzle placement, e.g. nozzles angled forward and downwards into the slipstream produce smaller droplets and a wider range of sizes than nozzles directed downwards, which in turn, produce smaller droplets than nozzles directed backwards.

Approximate droplet sizes - 1000 microns •

500 microns •

400 microns •

250 microns •

130 microns

1.5 Evaporation Spray effectiveness can be reduced when drops evaporate during their fall. For example, a 200 micron droplet will fall 80 m before evaporation at 80% relative humidity, but only 20 m at 50% relative humidity. A smaller droplet of 100 microns will only fall 7 m at 80% relative humidity and 2 m at 50%. Thus when spraying weeds in hill country (high flying) herbicides should be applied early in the morning when relative humidity is high and weeds are covered with dew; the alternative is to spray in the evening when the relative humidity again becomes high. Spraying in hill country can be undertaken during the day in winter - but check the relative humidity with a wet/dry bulb thermometer before starting. Evaporation can be reduced by adding a foam adjuvant (0.2%) to the spray mixture.

1.6 Dew A moderate dew can deposit 500 L of water/ha on the weeds to be sprayed. This assists the action of most herbicides. However, a very heavy dew will reduce the effectiveness of some herbicides that enter the plant through the leaf (e.g. Roundup (R), Gramoxone (R) because they are washed off the leaf when the dew runs off).

1.7 Wind A change in thinking has occurred in regard to the effect of wind on aerial spraying. In the case of low flying aircraft, wind is now regarded favourably.

If herbicides are applied in calm conditions some of the spray can go up instead of down and thus does not hit the target. The most dangerous situation is when an inversion layer (temperature of the air increasing with height from the ground) exists; this can usually be recognized by herbicide covering the windscreen of the aircraft after a spray run or by smoke settling out at a certain height and failing to fall to the ground. Spraying should be stopped under these circumstances.

The best conditions for aerial spraying are steady winds; however, gusty winds are quite acceptable because they vary the overlap which is largely compensated for on the next pass. Strong winds are also acceptable because they give reliable direction and greater swath overlap. The upper limit is generally dictated by the safety of the pilot. At wind

speeds in excess of 25 km/hr, conditions are normally so turbulent that the pilot will find it too uncomfortable to fly at a very low altitude. If he flies higher excessive drift will occur. As a general guide when spraying in hill country at a height of 8 m, maximum cross wind would be 10 km/hr. When spraying crops from a height of 4 m a 20 km/hr crosswind is the maximum that can be tolerated.

Light variable winds are not suitable as they can stop or they can change direction which leaves missed strips.

When spraying in hill country, steady light winds are the best. Naturally more care will have to be taken in hill country than in flat country to ensure drift does not cause damage to adjacent areas.

If spraying has to take place in calm conditions, assuming other factors are favourable, reduce swath width by one third to ensure strips are not missed.

The most important factor in using the wind is to ensure that the aircraft is flown at right angles to the direction of the wind. Don't worry about the shape of the paddock in formulating spraying direction, find the wind direction (smokey fire) and spray across this. Spraying with a following wind can greatly reduce swath width.

Wind speed can be measured by a small anemometer but if one of these instruments is not available the following is a rough guide:

(see over)

Description	Wind speed at 10 m above open flat ground. (Knots)	(km/hr)	Specifications for estimating speed over land.
Calm	1	1	Calm, smoke rises vertically
Light air	1-3	1-5	Direction of wind shown by smoke drift but not by wind vanes.
Light breeze	4-6	6-11	Wind felt on face; leaves rustle; ordinary vanes moved by wind.
Gentle breeze	7-10	12-19	Leaves and small twigs in constant motion; wind extends light flag.
Moderate breeze	11-16	20-28	Raises dust and loose paper; small branches are moved.
Fresh breeze	17-21	29-38	Small trees in leaf begin to sway; crested wavelets form on inland waters.
Strong breeze	22-27	39-49	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.

1.8 Drift Ensure the herbicide does not drift onto non-target areas. When spraying (low flying) in a 12 km/hr wind a 300 m barrier is necessary to protect non-target areas. A wider barrier is needed when spraying in hill country. Some aircraft can make smoke trails which allow the pilot to judge drift more accurately. Drift of spray in a 12 km/hr wind is considerably less than under near calm conditions.

1.9 Marking For accurate spraying the paddock extremeties should be measured with a tape and compass, and aircraft runs marked with pegs or yellow plastic. Human markers should guide the pilot by standing by the correct marker. With this technique the direction of the crosswind is not known before marking, so a system of pegging out should be used to allow spraying from either of two directions in case the wind comes from the opposite direction. On sunny days, use mirrors to attract the pilot (shine them 50 m to the front, not directly at the pilot). On cloudy days wave white or brightly coloured flags.

1.10 Pilot Good liaison between pilot and ground staff is essential. The pilot should be thoroughly briefed before spraying and radio contact between markers at the spray site and ground staff on the airstrip is a great advantage. Ensure that the aircraft has been properly calibrated before spraying and that the filter on the aircraft is clean.

1.11 Selective Removal of Weeds Where it is desired to remove a weed and leave useful species, e.g. removing serrated tussock from phalaris and subterranean clover, special consideration should be given to:

- applying the herbicide at a time which causes least damage to the useful species but kills the weed, e.g., in summer, subterranean clover and phalaris are dormant while serrated tussock is growing, herbicide application then will have minimum effect on the useful species while killing the tussock.
- applying the minimum rate of herbicide necessary to kill the weed. Sometimes, a rate of herbicide above the recommended rate is applied to ensure the weed is killed; this should not be done where selective removal of a weed is desired.
- accurate spraying with no overlapping of runs so that the recommended rate of herbicide is applied and not doubled up in the overlapped strips.
- not using a wetting agent as this reduced the selectivity of the herbicide.
- re-sowing improved species.
- special grazing management in the year after spraying, e.g., spelling the paddock from grazing and applying plenty of fertilizer so the useful species can recover from the herbicide and smother new weed seedlings.

2. Aerial Application of Seed

Seed of improved species should be sown to replace weeds after the residual effect of the herbicide has disappeared and after weeds have become affected.

2.1 Equipment If seed is to be aerially distributed alone, the aircraft should be fitted with seeding venturi or wing pods. Distribution of small seeds through the fertilizer distribution gate results in poor

spread. Wing pods will give a wider swath than a venturi but, with some seed mixtures, they tend to clog up and poor distribution results. Seed mixtures should be free from all string, tags, etc.

The flow rate of a seed mixture (e.g. grasses and legumes) should be checked before application. First, determine the flow rate from the aircraft on the ground and then test this over a known area. For example if the aircraft can sow 1 ha/min and the sowing rate is 5 kg/ha, then 5 kg of seed must flow from the aircraft per minute. Test this over 10 ha before sowing the whole paddock. If the seed mixture flows through the seeding equipment too fast to allow even spread, e.g. phalaris seed, add a bulky seed such as cocksfoot to slow the flow rate down.

2.2 Wind Ensure that the aircraft uses a crosswind to distribute the seed. The swath width of light seed, for example, cocksfoot, increases from 24 m to 30 m with an increase in crosswind velocity from 0 to 16 km/hr; however, the swath width of subterranean clover, a relatively heavy seed, is not affected. Thus in a seed mixture there is differential screening with the lighter seed being blown further downwind. There is also a drift of the whole swath away from the line of flight with crosswind. Providing the pilot knows the crosswind drift he can allow for these factors.

2.3 Altitude The effect of altitude by itself does not increase swath width but allows the seed more time in the air for wind to affect swath width. Little increase in swath width can be gained from flying above 60 m. Variability in swath drift can result from small changes in wind velocity resulting in overlapping of swaths in some parts of the paddock and lack of cover in other parts. This undesirable result can occur even at an altitude of 46 m with gusty winds in excess of 13 km/hr. Thus it appears wise not to aerially sow seed in winds above 13 km/hr.

Some swath widths (in m) for different seeds sown from different altitudes in conditions when the wind velocity was less than 6 km/hr follow:

(see over)

	Altitude sown from:		
	46 m	60 m	90 m
Cocksfoot	25	30	24
Perennial Ryegrass	21	25	22
White clover	17	19	20
Subterranean clover	23	24	24

2.4 Mixtures of Seed and Fertilizer When seed and fertilizer are mixed and spread together from the normal altitude of 30 m, spread of seed is at best two-thirds of the width of the fertilizer and at times less than half. Spread of seed from 120 m altitude can be as low as a tenth of that of the fertilizer.

Fertilizer and seed frequently segregate in bands. For example, the centre of a white clover seed swath was displaced from 3 m to 7 m from the centre of the fertilizer swath; corresponding figures for cocksfoot were 5 m to 12 m. These tests were conducted in winds from 0 to 13 km/hr.

From this it is clear that if the swath spacing flown is ideal for fertilizer there will be gaps between swaths of seed. The best method of overcoming this separation of seed and fertilizer is to reduce the swath width by half.

2.5 Split Sowings To improve the reliability of establishing seed from aerial sowing the total amount of seed should be sown, half with the fertilizer and half one to two months later from a seeding aircraft.

2.6 Marking Markers should be used to guide the pilot, the paddock being measured and pegged out prior to seed distribution.

3. Aerial Application of Fertilizer

Sown plants or survivng resident plants that replace sprayed weeds will need enough of the correct fertilizer for vigorous growth. The type and amount of fertilizer needed can be ascertained from paddock history, soil tests and test strips. Moderate to heavy rates of fertilizer are needed in the first 5 to 10 years of a pasture to ensure it gets through the clover dominant phase and into the grass dominant phase as quickly

as possible. Remember perennial grasses, e.g. phalaris ('Phalris aquatica), are the best weed controllers.

3.1 Losses of Fertilizer In the absence of wind, losses of the fine fraction of normal superphosphate from aerial distribution is small (less than 10%). Loss from granulated fertilizer is even smaller.

3.2 Evenness of Distribution Where there are no overlaps of adjacent swaths the efficiency of aerially distributed superphosphate (as measured by pasture production) was 72% of that from evenly spread superphosphate. If the swaths are overlapped (aircraft flown at swaths equal to the wing span width) the efficiency of spread rises to 80%. This is a result of uneven distribution of fertilizer across the swath and some areas receiving no fertilizer at all. Similar problems are evident in ground spreading of fertilizer.

3.3 Height of Flying Increases in swath width may be obtained by increasing the operating height from the normal 30 m to 120 m but distribution from 120 m could be uneconomical.

3.4 Swath Width The general swath width used for distribution of superphosphate is 20 m which is fairly well covered if there is a good cross wind. However, on calm days the swath width should be reduced to prevent stripping.

3.5 Markers To ensure the best coverage possible markers should be used to guide the pilot, the paddock being measured and pegged out beforehand.

Rope Wick Applicators - Innovative Weed Control

By Richard Walker,
District Agronomist,
Department of Agriculture.

Rope wick applicators are an exciting development in weed control. They offer selective weed control in situations where it has not been possible in the past.

They allow a non-selective herbicide to be applied directly to unwanted, tall growing vegetation.

How Do They Work?

Basically a reservoir of herbicide keeps a series of ropes wet. This is achieved through capilliary action and gravity. These ropes are then wiped directly onto the taller plants using a concentrated herbicide solution. The herbicide, Roundup (R), is then translocated through the plant leaving untouched plants unaffected.

Types Available

Three main types are available.

Pipewick or Boomwick: This unit has a single pipe into which the ropes are threaded.

Multirope: This unit has two parallel pipes about 45 cm apart. The ropes go from one pipe to the other and are at a slight angle to the direction of travel. A greater surface area of ropes is available for wiping weeds.

Hand held units: These units have been designed for home harden and market garden use but have application for spot treating weeds. They come in a variety of shapes and sizes.

Advantages of Rope Wick Applicators

1. Selective Weed Control: Because only the target weed is wiped, shorter growing plants are unaffected. The herbicide is non-volatile and is translocated. Any situation where unwanted vegetation grows taller than desirable plants is suitable for use with the rope wick.

2. *Environmentally Safe:* *Because the chemical is wiped on and there is no overspray, no drift and no chemical is sprayed onto the ground.*

3. *Economical Herbicide Use:* *Although a more concentrated dose rate is used, far less chemical is used. Rate depends on weed density and speed of travel. Dense weeds and slow speed use higher rates. Normal usage varies between 0.5 and 2.5 L per hectare of chemical.*

Problems

1. *Slow operation: 3 to 5 km/hr is best.*
2. *Wide beams: "whipping" results in some weeds being missed.*
3. *Irregular weed height: low growing weeds are untouched.*
4. *The same problem occurs with uneven ground.*
5. *There is no positive method of herbicide flow control.*
6. *Dense weeds cause chemical to be used quicker than it can be replenished, resulting in uneven weed control.*
7. *Dusty conditions can cause blockage of the ropes and can also deactivate the herbicide.*
8. *No suitable market system to show where the operator has been.*

Operation

As with spraying with Roundup (R), clean water is essential. If dirty water is used the chemical will be deactivated and blockages of ropes can occur.

Speed of operation should be between 3 to 5 km/hr. Up to 8 km/hr is permissable under good conditions.

Boom height is critical. It must be low enough to contact the top third of the weeds yet high enough to clear useful vegetation. Normal working height is about 30 cm.

There is some debate as to whether the unit should be rear or front mounted. With rear mounted units the tractor wheels can flatten weeds and they do not get treated. However, the operator can see where he is treating. Front mounted units overcome the above problem but in rough country unseen stumps and rocks can break off or damage booms. Also, the chemical wiped off under the vehicle may damage useful vegetation.

One pass is usually sufficient with multi-rope units under most circumstances, however, with the boom or pipe wicks two passes are suggested in dense weed situations.

Always use on actively growing plants.

Weeds

Roundup (R) is the only herbicide currently registered for use through rope wick applicators. Where Roundup (R) is registered for use as a spray it is O.K. to use through a rope wick as the registration states that Roundup (R) is registered for a 33.3 per cent solution (i.e. 1:2) for suppression or control of many annual and perennial weeds in non-crop and pasture situations.

Rushes: *Apply any time weeds are actively growing. Pre-slashing is desirable to even up plant height. Allow for regrowth before treatment. Follow up treatment may be necessary.*

Johnson grass: *Apply to actively growing plants any time. Best results are from flowering onwards. It is particularly useful on rhizome and seedling regrowth in irrigated lucerne.*

Cumbungi: *Burning the previous winter will ensure an even stand for treatment.*

Bracken fern: *If possible slash in spring and treat in late autumn. One pass from a multi-wick or two passes in opposite directions with a boom wick. Pasture improvement in addition will be necessary to give long term control.*

Horehound: *Good suppression has been obtained treating horehound in lucerne. Uneven weed height makes it difficult to get even control. Repeat treatment will be necessary.*

Thistles: *Variegated, saffron, black/spear, star. Treat any time from running up to flowering.*

Silverleaf nightshade: *Suppression only. Treat in late autumn from flowering to late berry stage. Leaf structure and prickles along the back of the leaf make it difficult to get good wiper contact.*

New Developments and Application Methods - State Rail Authority of N.S.W.

By A. B. McLennan, H.D.A., M.A.T.A.,
Agronomist,
State Rail Authority of N.S.W.

When is a technique "New"? What are "New" developments? The dictionary defines the word "New" as first made, invented, discovered, known, heard of or introduced. Accepting the interpretation of "New" meaning: First made and introduced, it then allows me today to talk about the changes which have occurred in S.R.A. Weed Control methods over the last three decades. In the late 40's, Fettling Gangs, who maintained about four miles of track, carried out weed control using the shovel.

A 44 gallon drum and rotary pump for "Camelia" application saw service in the early 50's, however, the fettler was still the "key" ingredient.

In the late 50's and early 60's a major development occurred. I quote from the Way and Works operation report of 1961:

> "7,000 gallon rail tankers equipped with motor operated pump and spray nozzles using modern Non-Toxic weedicides were used on all lines. This introduction reduced labour previously required for weeding with resulted large savings..."

Many modifications were made to these tankers between the 60's and 70's, however, a number of undesirable features remained:-

* Flat bottomed tanks
* Poor agitation (powder formulations)
* On face spraying used tremendous quantities of water
* Unsuitable for use as spot sprayers
* Locomotive required for track operation
* No accurate speed control (waste and inaccurate application)
* Failed to provide operator comfort and safety.

A new and more efficient tanker, W196 was placed into service in 1980. It featured such improvements as:-

* *Round tanks*
* *Reduced water requirements per hectare*
* *Solenoid controlled nozzles*
* *Operator comfort and protection*
* *Separate pumps and motors allowing simultaneous application of different chemicals.*

Tanker W196 provides ability to handle the modern chemical formulations and goes a long way to meeting requirements of the Pesticide Act, 1978.

In 1979 we used Agricultural type F/G tanks and booms mounted on trike and trailers. These proved very useful for "spot out" work in perennial grass control, however, because of their limited capacity they were restrictive in large scale operations - simply a logistic problem of supplying men, water and chemical.

Towards the end of the 70's, watering points within the State Rail System became virtually non-existant due to watering towers and tanks not being repaired following steam train removal. This, together with limited accessability to locomotive power for herbicide runs, suggested that alternate methods of Pesticides application were necessary.

Investigation into the use of Dry granular formulations were undertaken in 1978 and initial trials gave promise of obtaining:

* *Accuracy of application and swath*
* *No water required*
* *Variability of rates according to weed pressure*
* *Immediate cut off when required*
* *Increased flexibility of application timing*
* *Increase in track covered for similar volume or weight of load carried.*

Late in 1978, the proto type Macspred (R) Unit made an inaugural commercial application on the Mittagong to Picton loop line.

An acceptable "application unit" became the KEY to the concept. Some sleepless nights, many trial and errors later the technique of "fluidizing granules" was developed.

The next development was the gang car concept, these are virtually overgrown trike and trailer units. They provided increased load carrying capacity, ample power, a speedo, thus improving accuracy of application. The gang car trailer combination can be generally considered a successful piece of equipment for application of weedicide, particularly for granular formulations. When equipped with a 1000 to 2000 litre spray tank, they provide a very useful water phase unit for hard to handle summer grasses. Macspred (R) models MK3 and 4 were fitted to the Gang Cars GCX-1 and 2 and some 2,500 km of track was treated during 1980.

Concurrent with the granular development, the State Rail Authority were also evaluating the concept of 'ON-OFF' track units (Hy-Rail equipment) for pesticide application. (Those of you who attended the last conference in Wagga Wagga may recall the slides shown there.) The many advantages of this type of equipment lead to the acceptance in principal of the Hy-Rail concept for the decade ahead.

In September, 1982, we placed into service a unit combining both concepts. Our Vegetation Management Unit ##, VMX-1, is a 12 tonne Isuzu Truck fitted with Hy-Rail gear and equipped with a Macspred (R) Track Pack 3000A unit. With this equipment it is possible to apply three or four different chemicals simultaneously, vary the application rates according to the weed pressure and travel on good track at speeds up to 50 km/h. We are proud of the Unit. It is a world first and it is available for inspection and demonstration today.

It is worth mentioning that we have an alternate interchangeable body to enable VMX-1 to be used as a Water Phase Spray unit also. This unit comprises a two compartment stainless steel tank (2 x 3000 litre) -

Motor/Pumps solenoid controlled nozzles, electro-hydraulic operated booms and spray monitoring gear - all cabin controlled. Unfortunately, it is impossible to provide this unit for inspection but the slides will show the unit in operation.

Please join with me and my rail colleagures at the station yards now for a demonstration, featuring the Hy-Rail Unit VMX-1 mounted with electronical controlled Macspred (R) Model 3000A unit.

Our GCX-2 water phase unit can also be inspected.

(R) = Registered Trade Name

Weeds in Urban Bushland

By Leon W. Smith,
Principal Agronomist (Weeds),
Department of Agriculture.

1. Bushland

Native bushland can be described as land where the vegetation contains an important component of indigenous plants, and where any introduced plants can be thought of as weeds.

A large number of introduced plants have become naturalized in N.S.W. and many of these are mixing with the populations of indigenous plants in bushland areas so that, on a century-long time scale, new communities of plants are being formed which are a mixture of indigenous and introduced species. Such mixed communities may come to be regarded as bushland in the future, but at the present time the term is understood generally to refer to indigenous vegetation. In any event, the term 'native bushland' avoids any confusion.

2. Urban Native Bushland

Urban areas (cities and towns) have spread rapidly so that bushland often adjoins or is contained within developed urban areas. The regions of Sydney, Newcastle, and Wollongong are all prime examples, but many smaller urban centres throughout N.S.W. are also involved. The growth of urban areas is continuing to create new interfaces between town and bushland. Bushland which is in contact with urban areas, or which is affected by pressures created by urban areas and their development, or which contributes important resources to the quality of urban life can be considered to be urban bushland. This description could form the basis of a working definition of urban (native) bushland.

3. Values of Urban Bushland

Heritage. Australian native plants are as interesting and as unusual (in comparison with plants from other parts of the world) as our animals. For the urban-based majority of our population, bushland in and near cities and towns provides their major contact with this heritage.

Education. Urban bushland is an important resource for all levels of education, primary, secondary, tertiary, technical, and continuing education. A great number of institutions currently utilise urban bushland as an outdoor laboratory and field resource for study of biology, geology, geography and social studies.

Recreation. A wide range of passive recreation and children's play is carried out in urban bushland, particularly as a contrast to the high-pressured aspects of urban living.

Scenic. Urban bushland provides visual diversity within the developed areas and adds materially to the attractiveness of urban areas to quote only two examples:-

- *the bushland areas of Sydney are as essential as its waterways for the overall beauty of the city;*
- *the escarpment and its vegetation flanking the Wollongong region is essential to its scenic beauty. On a smaller scale, nearby bushland is valued by local residents and has real estate value.*

Air and Water Quality Control. Vegetation modifies air temperature and screens particulates from urban air. It stabilises soil and reduces the rate and volume of storm water runoff. It provides "buffer zones" between industrial and residential areas which assists noise abatement.

Many people value bushland as habitat for wildlife. It should be emphasised that the many benefits of native bushland exist at little or no cost to the community. Conserving and maintaining these areas will undoubtedly require a continual source of financial input.

4. Urban Pressures on Bushland

Urban development exerts several pressures on bushland. These pressures constitute forms of disturbance to the native bushland. Disturbances range form permanent loss of bushland to an overall tendency for nutrient enrichment in soils. The pressures include:-

- *erosion and siltation from land clearing and construction adjacent to or in the same drainage basin as the bushland*
- *alienation of bushland for more intensive direct urban development*
- *alienation of bushland for purposes ancilliary to urban areas such as routes for urban services (power, sewerage, water, gas), community clubs and sports areas, rubbish dumps, parking areas, expressway routes, and many others*
- *altered drainage patterns of stormwater and altered chemical composition (enrichment in plant nutrients)*
- *rubbish dumping*
- *incursions of wheeled vehicles*
- *severely altered fire regimes and construction of fire trails and breaks*
- *trampling*
- *introduction of a wide range of domestic and feral animals*
- *overall tendency for nutrient enrichment in soils*
- *introduction of numerous weed species, often in large quantities*
- *garden escapes*
- *development issues - planning.*

Despite these pressures, experience shows that native bushland can be maintained within and adjacent to urban areas by appropriate methods of management. The native plant species making up such bushland are likely to show changes through time in response to pressures which cannot easily be controlled. Urban native bushland should therefore be regarded as dynamic communities of plants, rather than as static representatives of the original vegetation which in any event is usually poorly recorded.

5. *The Weed Problem*

Settlement in general, and urban pressures in particular, create a major weed problem for urban native bushland. Large numbers of species of introduced plants have shown their ability to colonise bushland particularly following disturbances of the types listed above. Disturbance of the existing vegetation, the plant litter, the soil and its nutrient levels, the fire regime and so forth all create conditions liable to favour establishment, growth, and spread of weeds.

Successful methods for the control of weeds in urban native bushland must conform to the principal of creating minimum disturbance during the weeding operations. High disturbance methods of weed removal result in renewed serious weed infestation. Such operations are a waste of money in the long term and exacerbate the weed problem in the treated area. High disturbance will occur with unskilled personnel, with large machinery with broad-scale chemical methods, and when the weeding operations proceed too quickly over too large an area. The methods of weed control pioneered by J. and I. Bradley (ref.) are effective. They conform to the principle of creating low disturbance during the weeding operations. These methods should be regarded as setting a pattern, or style of operations suitable for weed control in bushland.

Observations and experiments carried out in the Sydney area confirm several views about weed control in urban bushland:-

- *Methods of weed control which create high levels of disturbance to the site or which merely prune the weeds are not successful and, effectively waste money. They favour an increase in the weed problem.*
- *Methods of weed control which minimise disturbance are effective but require skilled operators.*
- *There is a group of introduced plants (twenty or more) which are serious weeds in urban bushland in the central and coastal region of N.S.W. The problem extends beyond the well known weedy plants such as the two privets and lantana. Weed control in bushland involves knowing how to handle all the major weed species.*
- *Decisions about precise methods of weed control and management should be made individually about each bushland area on its own merits.*

- *Chemical methods of weed control have a place but should be used with caution in the urban environment. Injection of herbicides directly into the bark and youngwood of large standing specimens of the two species of privet shows promise. Herbicides which minimise the residue problem are desirable. This method avoids the disturbance caused by felling trees and large shrubs.*
- *Control of large specimens such as privets is difficult by non-chemical methods. Some promise is held out for broad-leaved privet by methods which exclude light from stumps in order to prevent successful suckering. This method does, however, disturb the site when the tree is felled.*
- *It is concluded that weed control is practicable in urban bushland by appropriate methods and that these methods exist but require further development.*

6. *Future Action*

Schools of Horticulture and Agriculture should be encouraged to include instruction on management of urban bushland and on weed control in their curriculum.

Extension publications should be made available to the public, councils, etc., about urban bushland management, pressures from adjoining urban areas, and weed control.

A category of weed plants should be established by legislation for urban weeds and which discourages the sale or spread of bushland weeds.

The major aim should be for public education so that urban weeds are not allowed to develop in the first instance and that correct measures are taken when the weeds occur so that the problem does not recur in the future.

Brush and Scrub Control in Western Lands Using Residual Herbicides

By B. M. Alchin,
Executive Assistant,
Western Lands Commission.

1. Introduction

The spread of native scrub (inedible woody weeds) is the most serious cause of reduced productivity in western New South Wales.

Millions of hectares are already affected, with the potential for greater than 20 million hectares or 60% to 70% of the Western Division to have its productivity reduced.

Up to date, there has been little use of herbicides to control scrub regrowth in western New South Wales. The high labour costs, time involved, cost of the chemical and, to some extent, the limited availability of water, have been the main factors limiting herbicide use by conventional application techniques.

The development and availability of point-application techniques led to investigations by the Western Lands Commission, in co-operation with Du Pont (Australia) Limited, to consider their potential for use in western New South Wales.

Hexazinone formulations used were the liquid[1], elliptically-shaped pellets[2] and granules. The liquid formulation was applied with a soil-injector gun[3] connected to a back-pack container. Comparisons were made with high volume spraying and misting applications. The pellets and granules[4] were applied by hand.

The liquid formulation contains 250 grammes of active ingredient per litre of solution. The "Spotgun" has exchangeable nozzle attachments which allow for the application to be placed on top of, or just below, the soil surface.

1. Trade name Velpar L
2. Trade name Velpar Gridball Brush Killer
3. Trade name Spotgun
4. Trade name Velpar 20G

Three different sizes of pellets have been used - 2.00 grammes (10% a.i.), 3.75 grammes (10% a.i.) and 1.80 grammes (20% a.i.).

The granules vary in size from 1 to 3 mm in diameter.

The point application with the soil-injector gun or the pellet usually involves placement at the drip-line of individual shrubs or on a grid-pattern for dense stands (refer diagram).

The first trials were set down in 1978. These were to determine the potential of point-application of hexazinone for suppressing regrowth of mallee and other shrub species on fire trails in the Mt. Hope district.

2. *Hexazinone Uptake and Activity*

Hexazinone is readily absorbed by plant roots, but is also absorbed by leaves.

Following application to the soil, hexazinone requires downward moving soil moisture (following rain) to relocate it in the root zone as a concentrated core of chemical. The more active the plant is growing, the greater is the uptake and transport within the plant.

Hexazinone affects leaf growth and activity by inhibiting photosysnthesis. By this mode of action it can affect all plant species to some degree.

The photosynthesis-inhibiting action means that the rate of death of the plant depends on the relative growth activity which, in turn, depends on seasonal conditions. Most woody speoies have the ability to regenerate after defoliation and, since hexazinone is only functioning when green leaves are present, the rate of response will depend on the seasonal conditions and the degree of reserve for refoliation within the individual plant. Observations in western New South Wales have indicated that death can occur in 3 to 18 months. However, a small proportion of plants, particularly Eucalypts, may continue to defoliate-refoliate for 3 years or more. Death is effected when the plant has exhausted its reserve for refoliation (refer diagram).

3. Residual Characteristics of Hexazinone

Hexazinone is resistant to degradation by ultra-violet light (sunlight) but is subject to microbial decompostion.

Under temperate (USA) conditions, the half-life has been stated as approximately 6 months. Observations in western N.S.W. indicate that the period may be significantly longer under semi-arid conditions.

4. Factors Affecting Response to Application

Results of trials have provided the following guidelines and information on application:

4.1 Application Rates

A general guide to effective individual plant application rates for most plants which occur as shrubs or tree suckers or saplings is:

Table 1: Application Rates and Costs for Individual Plants

Plant Dimension	Rates and Cost per Plant			
	g a.i.	vol.liquid (1) (mL)	no. of pellets (2)	cost of chemical (3)
less than 1 m high	0.5	2	2	4 cents
1 to 2 m high	1.0	4	3	8 cents
greater than 2 m high	2.0	8	6	16 cents

4.2 Comparison of Formulations and Application Techniques

4.2.1 High Volume spot spraying

Limited trials indicated that this was the least effective and most time-consuming of the techniques used. The lack of response was partially attributed to the poor leaf absorption characteristic of hexazinone.

(1) i.e., of hexazinone solution
(2) based on the 1.8 g pellet
(3) based on price of $20 per litre for "Velpar" solution (there is no commercial price available for the pellets).

4.2.2 Misting

In most trials, misting (1% solution, applying approximately 2.5 g a.i. per plant) produced the most rapid defoliation but the eventual regeneration and survival of plants was higher than for all other techniques, except high volume spot spraying. However, on one trial with very young sandalwood ('Eremophila mitchellii') seedlings, 100% death was effected.

It appears that misting may be an acceptable technique for very young plants.

4.2.3 Soil Injection to Individual Plants

Provided the application rate was adequate, this technique has proved particularly effective.

There was no difference in response for application on or below the surface on level, sandy soil areas.

A particular advantage of this technique is the large number of applications available per unit volume or per unit weight of chemical.

It is important that the "Spotgun" be aimed at an angle as close to the vertical as possible. Angles close to the horizontal result in too much scatter of the liquid. The "Spotgun" should also be held as close to the soil as possible.

It is essential that the "Spotgun" be cleaned thoroughly after use - and at least at the end of each day. Clean water should be pumped through the gun until there is no trace of "Velpar" evident. The gun and attachments should also be cleaned on the outside with clean water. A few drops of light oil should be used to lubricate the moving parts.

4.2.4 Pellet Application to Individual Plants

This formulation was, usually the slowest to effect response. However, on comparing rates of application, it frequently resulted in higher percentage kills than for the soil injection technique.

The relatively high effectiveness of this formulation in semi-arid areas is tentatively based on the process of release and uptake. The pellet would remain virtually undegraded until significant rain falls. At that time, the pellet would begin to disintegrate and release the active ingredient. This would then move down the soil profile under the influence of soil moisture. At the same time, the plants' absorption roots would have been stimulated into activity by the rain. These simultaneous events of herbicide release, herbicide transport and active plant growth under the influence of significant rainfall events results in maximum response to application.

A similar process occurs with the soil injection application. However, the liquid which has not yet reached the root zone is more subject to degradation than the pellet. Also, the liquid would tend to be transported downwards after light rainfall events which may not be sufficient to significantly stimulate root activity and plant growth.

4.2.5 Soil Injection and Pellet Application to Dense Stands

Grid pattern application, with relatively small quantities of active ingredient being applied to each point, significantly reduces the amount of herbicide applied per hectare compared to treating individual plants.

As a general rule, where the average distance between plants is less than 2 to 3 times their height, it is more efficient to use grid pattern application rather than treating individual plants.

4.2.6 Time of Application

Results from trials have indicated that the optimum time for rapid, effective response is when there is high soil moisture and the shrubs are growing actively. (Active growth can occur at any time in spring and summer). It is necessary for rain to follow after application to move the chemical into the root zone.

4.2.7 Placement of Application

Application to the drip-line of shrubs appears to be the optimum placement. Although rapidity of response may vary in relation to soil moisture conditions and placement location, the drip-line site provides a balance between the variation.

The liquid or pellet formulation should be placed on bare soil - care should be taken to ensure that the application does not go on to non-target pasture species or vegetative litter.

4.2.8 Number of Points of Application and Dilution

Increasing the number of points of application (for the same quantity of active ingredient) increases the response. Dilution of the liquid (for the same quantity of active ingredient) also increases the response. These two factors can be combined to develop application with increased number of points through dilution.

The usual recommendation now is -

dilute hexazinone liquid 1 to 4

apply 5 ml "shots " of the diluted mixture -

less than 1 m high - 2 x 5 ml

1 to 2 m high - 4 x 5 ml

greater than 2 m high - 8 x 5 ml

The "shots" should be equally spaced around the drip-line, or toward the up-hill side if there is any localised slope.

4.2.9 Volume of Liquid for Application

Application with the "Spotgun" should involve at least 4 ml of liquid per point. Volumes less than 4 ml do not concentrate enough at one point. Also, the higher volumes tend to create their own indentation in the soil. This reduces lateral movement and increases concentration in vertical movement.

4.2.10 Soil Type

The soil type, particularly the clay content characteristics, affects the availability of hexazinone. The more clay there is in the soil, the more "binding" there is of the hexazinone. The hexazinone bound to the clay particles is not available to the plant. On deep, sandy soils there may be significant loss through leaching.

4.2.11 Affect on Pasture

Pasture, within the immediate vicinity of the point of application is killed by hexazinone. Observations indicate that regeneration by medics and clovers occurs about 12 months after application. By 2 years after application the previously bare areas are supporting a typical pasture. The rate of regeneration depends on rainfall.

The bare areas are generally 30 to 50 cm in diameter. However, this only reduces pasture production by a relatively small amount. For most stands which would be treated as individual plants, the area of pasture affected would be less than 1%. For grid patterns the area affected would be:

Grid Spacing (m)	% Area of Pasture Affected
1.4	10%
2.0	5%
3.0	2%

5. Species

The following trees and shrubs involved in trials are listed in generally decreasing order of susceptibility:

Trees (both mature and regrowth)

bimble box ('Eucalyptus populnea')

coolibah ('E. microtheca')

white wood ('Atalaya hemiglauca')

mulga ('Acacia aneura')

mallee ('Eucalyptus spp.')

yarran ('Acacia homalophylla')

white pine ('Callitris columellaris')

gidgee ('Acacia cambugei')

Shrubs

punty bush ('Cassia eremophila')

boxthorn ('Lycium ferrocissimum')

wilga ('Geijera parviflora') regrowth

emu bush ('Eremophila longifolia')

mimosa ('Acacia farnesiana')

mesquite ('Prosopis juliflora')

hopbush ('Dodonaea attenuata')

turpentine ('Eremophila sturtii')

budda ('Eremophila mitchellii')

lignum ('Muehlenbackia cunninghamii')

It has been observed that kurrajong ('Brachychiton populnea') and warrior bush ('Apophyllum anomalum') are relatively tolerant to hexazinone.

6. The Role of Herbicides in Scrub Control

There are several specific roles for herbicides in scrub control.

6.1 Control in areas where scrub is encroaching

On areas where scrub regrowth is actively encroaching on millions of hectares of rangelands the shrubs are at varying spacings but, overall, the country is still relatively open. The cost of treating these areas with hexazinone applied through the "Spotgun" is shown in the table below:

Table 2. Cost for Application of Hexazinone with the "Spotgun"/

Plant Density (No./ha)	*Approx. Spacing between Plants (m)*	*Cost of Hexazinone ($/ha)*	*Time Involved (min/ha*	*Cost of Labour ($/ha)*	*Vehicle Cost ($/ha)*	*Total Cost ($/ha)*
114	*10*	*$9.12*	*25*	*$2.08*	*$0.06*	*$11.30*
28	*20*	*$2.24*	*5*	*$0.40*	*$0.03*	*$ 2.70*
5	*50*	*$0.40*	*1*	*$0.08*	*$0.01*	*$ 0.50*
1	*100*	*$0.08*	*0.5*	*$0.04*	*$0.01*	*$ 0.10*

Note:

Cost of Hexaxine - *based on cost of $20 per litre and assuming plants are 1 to 2 metres high - application rates are as in Table 1.*

Time Involved - *based on 5 second application time per plant, plus travelling speed of 5, 10, 15 and 20 k.p.h. respectively, for the four different densities:*

Cost of Labour - *based on $5 per hour*

Vehicle Cost - *based on $0.05/km for motorbike*

Total Cost - *rounded to nearest $0.10*

A typical area of scrub encroachment would have 1 to 2 metre high shrubs at about 28 plants per hectare. This would cost approximately $3/hectare for treatment. Assuming an average run of seasons, it would be necessary to treat the areas about once every 5 years. The cost can then be considered as $0.60/ha/year. These costs are for the area treated only. However, the whole property benefits by the reduction of the potential seed source.

Where shrubs are at less than 20 metres apart it becomes difficult to manoeuver a motorbike and it may be more efficient to walk. Small, dense clumps do not require application to each shrub - modified grid pattern can be used.

A check of which plants have been treated can be maintained by the use of a dye in the liquid (e.g., rhodamine red). Observations indicate that the "spot" is visible until rain falls (i.e., for several weeks or even months).

From Table 2, it can be seen that the cost of treatment increases rapidly with increasing plant density and from Table 1 there is significant increase in cost of chemical per plant as the plant height increases. Hence, the cost of treating encroaching scrub areas can be kept to a minimum if application is made as soon as shrubs appear (i.e., when they are small and at low densities).

The pellet formulation is particularly applicable to this role of herbicides. A container can be carried on a vehicle and applied to individual plants or small clumps when other property work is being carried out (e.g., mustering). This would reduce the labour and vehicle costs and, over a period of time, would effectively reduce or contain shrub encroachment.

6.2 Control of isolated, dense stands of scrub

Dense stands of scrub may occur in otherwise relatively open country. These stands can interfere with mustering and access to water and serve as a harbour for vermin, as well as being an abundant source of seed for further infestation. Although the cost of treatment per unit area may be relatively high, this can be offset by the benefit to an area much larger than the stand itself.

Rates of application trials for dense stands are not as advanced as for individual plant treatment. However, the results to date are presented in the table below.

Table 3. Cost of Treatment of Dense Stand of Scrub, 1 to 2 m high at 3000 plants per hectare (approx. 2 m apart).

Rate per Point g (a.i.)	Grid Spacing (m)	Cost of Chemical ($/ha)	% Mortality	Extra Cost to Effect 100% Mortality	Total Cost to Effect 100 % Mortality
0.25	1.4	$102	>90%	$24	$126
0.25	2.0	$ 50	>80%	$48	$ 98

Notes:

Cost of Chemical: $20 per litre

Extra Cost : assumes treatment of remaining 10% of plants as individuals

Total Cost : sum of grid pattern and individual plant treatments.

Although the costs per hectare noted above are high, current trials indicate that this cost may be significantly reduced by dilution of the liquid and the use of a smaller grid.

Considering the cost of chemical alone, it appears to be more economic to use a grid pattern application rate that results in significantly less than 100% mortality, than to treat the survivors as individuals.

6.3 Control of timber and scrub regrowth following clearing

Clearing to develop country with dense stands of timber and scrub has increased in recent years. Once clearing and raking is completed regrowth is inevitable. Although cultivation may be carried out in some areas, it is not always possible. Application of hexazinone through the "Spotgun" has proved to be a very economic method of controlling regrowth. The costs are as indicated in Table 2 for encroaching scrub areas.

6.4 Control of undesirable trees and large shrubs

Dense stands of mature trees and large shrubs have developed in certain areas. These trees are a major problem in property development and management. The main species are bimble box, budda, coolibah and white pine.

Injection of hexazinone into the trunk of mature trees or large shrubs appears to be an effective and economic means of control.

Trials are still being assessed for this aspect but results to date are very encouraging.

Table 4 indicates the expected cost of application:

Table 4. Cost of Hexazinone for Tree Injection

Tree Diameter (cm)	*Number of Cuts per Tree*	*Cost of Hexazinone per tree (cents)*
< 15	1	2
15-<30	2	4
>30	-	-
40	6	12
60	9	18

The figures in Table 4 are based on injection of 1.0 ml of hexazinone per cut. However, one recent trial has indicated that dilution may greatly enhance the response. In that trial, 90% of coolibah trees died when treated with a 1:5 dilution of hexazinone at 1 ml/cut/30 cm diamter for trees. This means that a 30 cm diameter tree can be killed for a cost of 1.2 cents for hexazinone.

6.5 Aerial application of pellets

Simulated aerial application trials with pellets have indicated that this technique could be used to open up areas of dense timber and scrub. Fire could then be used to further develop the area with an integrated programme of fire and herbicide application then being used to maintain the area. However, the commercial cost of both the pellet and aerial application will determine the economics of this.

7. Integration of Herbicides with Other Control Techniques

7.1 Fire

Fire is the most economical method of large scale control of shrub regrowth. However, it is limited by the infrequent occurrence of sufficient fuel, its lack of usefulness in dense stands, its low effectiveness on large shrubs and grazier resistance to burn pasture.

Trials have shown that less hexazinone is required to kill as shrub that has been burnt compared to a similar shrub that has not been burnt. Application of hexazinone is a valuable technique to increase the mortality of shrubs following a fire.

It is important to note that hexazinone should not be applied immediately after a fire. The activated carbon in the soil can bind the chemical up, rendering it unavailable to the plant. At least three weeks should elapse between the fire and application of the chemical.

7.2 Mechanical

Mechanical control is not practised widely except where cultivation can be used after the initial clearing. However, the "Spotgun" application of hexazinone has proved to be very effective to control regrowth after clearing and cultivation.

Where mechanical control is feasible, it is possible that a programme involving clearing, fire and chemical application will be applicable.

7.3 Goat grazing

Goats can significantly reduce the density of some shrub species. Any remaining shrubs are heavily defoliated and are readily killed by application of hexazinone.

8. Future Developments

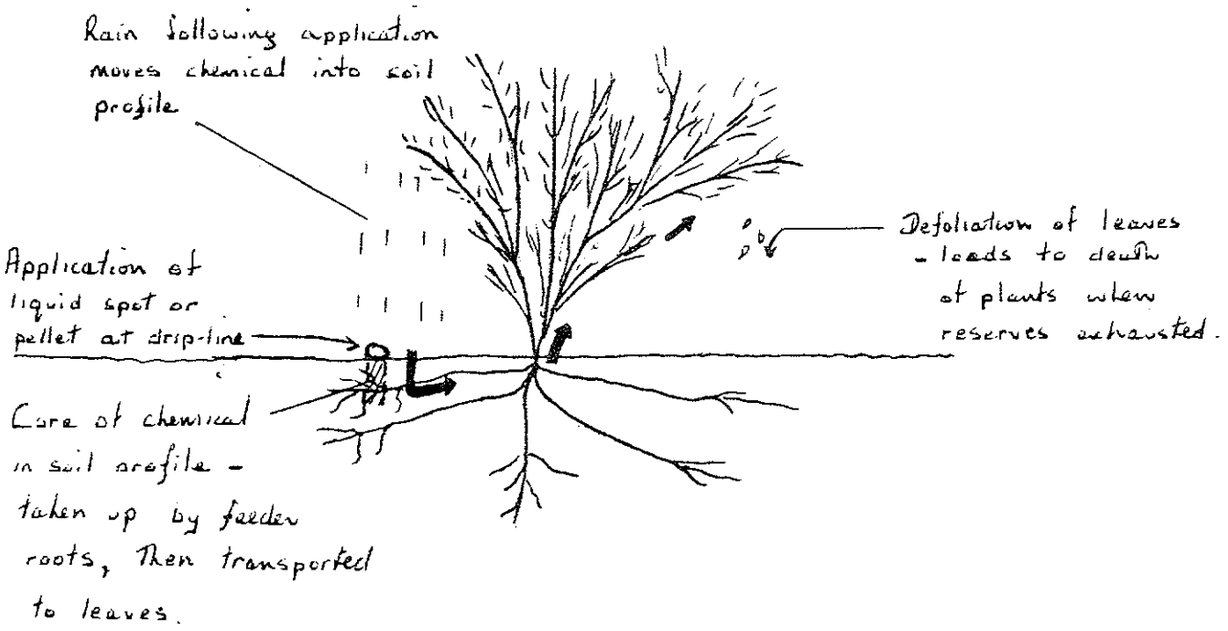
Data from the trials will be used to register liquid hexazinone applied with the "Spotgun" on species in western New South Wales.

Registration for pellets may still be some way off because of consideration of economics of manufacturing.

Data for current trials is still being assessed. Recent trials have included the use of granules to control weed growth along fence-lines. Further trials will be carried out to clarify factors discussed in this paper.

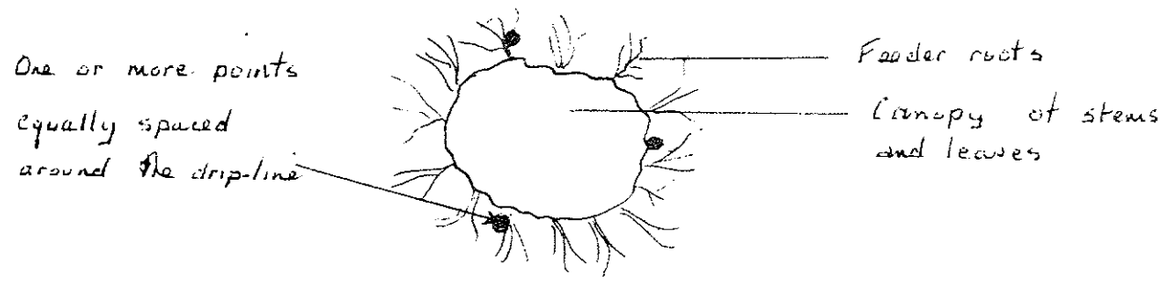
Point Application of "Velpar"

Uptake and Activity



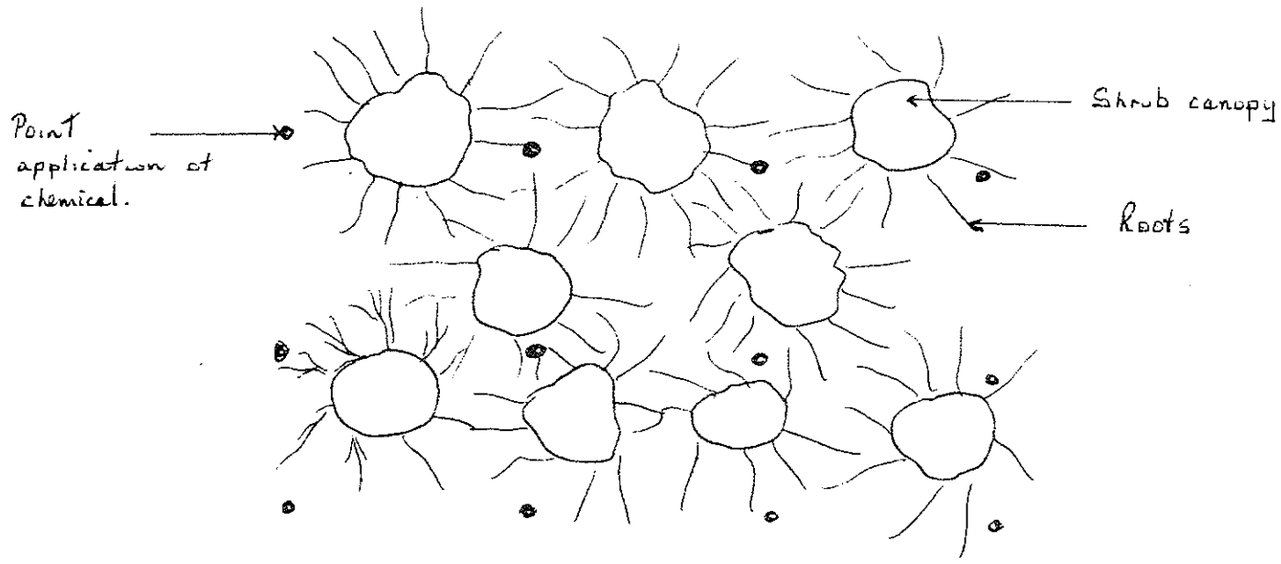
Application to Individual Plant

(Aerial view)



Application to Dense Clumps

(Aerial view)



One point is taken up by several plants. Each plant draws on one or more points.

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Computerised Herbicide File

Bruce Howie,
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Roche-Maag Limited.

Herbicide decisions are generally based on the following criteria:

1. *Weed problem.*
2. *Safety to desired species.*
3. *Cost.*
4. *Period of control required.*

With the wide range of herbicides now available, and the overlapping features of this range, a filing system which can sort herbicides on the above criteria becomes desirable for better decision making.

Because of their capacity to conduct a file search with speed, accuracy and completeness, computers have provided the opportunity to develop such a filing system. Roche-Maag Limited have sought to utilise the features of data base search facilities to develop comprehensive packages which will list herbicide options for a specified task.

Development of the Packages

The project commenced mid 1982 with the co-operation of Farmplan Australia Pty. Ltd. The initial work used the Farmplan Data Plan as the data base and concentrated on a small range of crops, weeds and herbicides. The objectives of the pilot program were simply:-

1. *To develop a rapid search facility which could provide accurate herbicide information for specified situations allowing an informed recommendation based on such information as crop safety, weed spectrum controlled, rate of application and cost per hectare of chemical.*
2. *That the above facility be available to users of low cost desk top computers.*
3. *To test the potential of the concept with anticipated users.*

Using Dataplan it was possible to achieve the first two objectives with some limitations.

Objective 3 was evaluated by demonstration of the pilot package during field days at Gunnedah and Orange, and in individual demonstrations to interested parties. Positive responses were obtained from farmers, chemical resellers, Department of Agriculture personnel, Weeds Officers, Agriculture teachers, sales representatives and various others.

Dataplan Limitations

It was found that the format of Dataplan did not allow sufficient space to incorporate all the necessary features for a comprehensive system. Limitations were placed on the number of crops, number of weeds and the number of rate x weed growth stage combinations which could be permitted. It has therefore become necessary to investigate alternative data base software or prepare an individual data base. Specification of the search parameters in order to set the search in motion has also proven to be time consuming and cumbersome with Dataplan. This is expected to be overcome with a new data base.

Structure of the file

The file has four main zones:-

1. *Chemical information - basic information about the chemical - trade name, active constituents etc.*

2. *Crop information - in particular chemical registration for various crop growth stages.*

3. *Weed information - registration on listed weeds and appropriate rate for various weed growth stages.*

4. *Cost information - a function of chemical cost and rate of application.*

These four zones contain the information that will be required to determine the suitability of a herbicide for a particular purpose.

Herbicide Search

A search of the file can be carried out by determining which are the critical factors in a particular situation. Such factors are likely to be say crop, crop growth stage and weed species in a cropping situation.

In a non-crop situation perhaps weed species, weed growth stage, residual or knockdown requirement may be typical critical factors.

These critical factors (search parameters) are specified in setting up the search on the computer and then the computer proceeds to check each herbicide on file for compliance with the set parameters, selecting those which do comply fully.

In setting up the search it is important firstly to ensure that the search parameters are specific and sufficiently restrictive to produce a reasonably limited list of herbicides. For example if the computer were asked to search out a herbicide with just one search parameter specified, e.g., "WHEAT", a large and varied list of herbicides would be produced. It is better to restrict the report by specifying a further parameter such as crop growth stage.

On the other hand if too many search parameters are set then it is possible to make it so restricted that the computer finds no herbicide capable of meeting the requirements. For example if the following parameters are set, "WHEAT", "TWO LEAF STAGE", "WEED SPECIES CAPEWEED, WILD RADISH, BLACK OATS, TURNIP WEED, RYEGRASS", "APPROVED AERIAL APPLICATION", "COST ⟨$4.50 PER HA" it is unlikely that any herbicide will measure up to the requirements. It may be better to conduct more than one search each with fewer parameters and select perhaps two herbicides which will achieve the required result.

Report format

A search can be arranged so that simply a list of herbicide trade names is produced in the report - each product listed meeting the requirements of the search. This may be sufficient information. However, it is possible to have the report set up to provide more information from the file than that which was specified in the search. Consider a search on "OATS", "CROP LEAF STAGE", "WEED SPECIES WILD RADISH, WIREWEED". In addition to obtaining a list of suitable herbicides it may be of interest to know if the herbicides selected would

(a) be safe at the 4 leaf and through early tillering stages

(b) control some other weeds

Further, information relating to rate of application at various weed growth stages may be valuable along with the relative cost per hectare of the chemical.

This additional information can be obtained from the file when the report format is being determined. The result is a printed report listing all the options along with the necessary information to select the most suitable herbicide (Table 1).

Full details of a product, if required can be obtained by using the reference number on the report and asking the computer to print the whole file on that particular product.

Future Development

This type of search facility is seen by Roche-Maag Limited as providing a practical and prompt service to users of our products. Decision making is improved and made considerably more efficient. If search parameters are well selected suitable products will not be overlooked and time will not be wasted on manual label searches.

It is proposed that the data files and search program will be made available to potential users in discrete packages covering use areas such as winter crops, summer crops, non-crop/industrial. Thus the number of herbicides on each file will be restricted, to enable more rapid searches to take place. The packages will initially be written for use on Apple II desk top computers with the possibility of later conversion to other computers.

File updates, to include new products, new registrations and price information would be performed at regular intervals by Roche-Maag Limited and made available to users.

PREPARED

BY ROCHE-MAAG LTD WITH FARMPLAN PTY LTD COMPUTER SYSTEMS

HERBICIDE FILE REPORT

OATS .... EQUAL TO Y
CROP LEAF 5+ .... EQUAL TO Y
WILD RADISH .... EQUAL TO Y
WIREWEED .... EQUAL TO Y

REF. NO......	TRADE NAME..	CROP LEAF 4.	CROP LEAF 5+	EARLY TILL..	CAPEWEED....	PAT CURSE...	SAFF THISTLE	SPINY EMEX..	WILD MUSTARD	WILD RADISH.	WIREWEED....	SEEDLING....	ROSETTE.....	& $/HA SDG..	& $/HA ROS.
0001	BARREL	Y	Y	Y	Y	N	N	Y	Y	Y	Y	1.00	1.40	11.44	16.02
0002	BARRAGE MA	N	Y	Y	N	Y	Y	*	N	Y	Y	1.8	1.8	20.53	20.59
0005	BUCKSHOT	N	Y	Y	Y	N	*	Y	Y	Y	Y	1.0	N	6.15	0

TABLE 1: HERBICIDE FILE REPORT LISTING CHEMICALS TO CONTROL WILD RADISH AND WIREWEED IN OATS AT THE 5 LEAF STAGE. APPLICATION RATES AND COST PER HECTARE FOR CONTROL OF SEEDLING AND ROSETTE STAGE OF WEED GROWTH ARE SHOWN ALONG WITH ADDITIONAL WEED AND CROP TOLERANCE INFORMATION.

ALWAYS REFER TO THE LABEL ON THE CONTAINER.

Roundup Herbicide

By Rob Anderson,
District Manager,
Monsanto (Aust.), Ltd.

New Recommendations

Blackberry	Rate 1.3 L to 100 L water. Handgun recommendation only. Beware of plants under stress of high temperature or drought. Visible symptoms may be slow to develop and may not be fully apparent until the next season. Followup spot treatment in the next season may be necessary to ensure full control.
Boxthorn	Rate 700 ml to 1.0 L per 100 L water. Complete plant foliage cover is essential. Do not spray during hot dry summer period.
Crofton Weed	Rate 500 mls per 100 L water. Apply to actively growing plants with full foliage. Retreatment and/or pasture improvement is recommended to restrict seedling re-establishment.
Cumbungi	Rate 1.3 L per 100 L water. Apply to actively growing plants at early head to full head stage.
Lantana	Rate 1.0 L to 100 L water. Spray when plants are actively growing with full foliage. Do not spray during periods of summer drought stress. Followup spot treatment in the next season may be necessary to ensure full control.
Silverleaf Nightshade	Rate 2.0 L per 100 L water. Spray only under good soil moisture conditions. Apply at the late flowering to berry stage. Repeat spraying may be necessary to restrict regrowth and seedling re-establishment.

St. John's Wort — *Rate 500 mls per 100 L water. Apply to actively growing plants in the flowering to post-flowering procumbent stem stage, (generally November to May).*

Rushes — *Use Wiper equipment as per label instructions. 1 part Roundup (R) to 2 parts water. Wipe rushes at anytime when they are actively growing and are not under stress of drought or frost.*

Bracken Fern — *Use wiper equipment. (1:2)*

1. *Pre-slash bracken to remove existing population of fronds during October/December.*
2. *Allow regrowth such that new fronds are fully unfurled and actively growing. This is usually around March to May.*
3. *Treat with Roundup (R) herbicide through Wiper Equipment.*
4. *Repeat treatment in the following season is advisable. Where pre-slashing is not possible, repeat treatments will definitely be required.*

Bitou Bush (Boneseed) — *Registration Application has been submitted on Roundup herbicide use on Bitou Bush. Anticipated recommendation will be - 1 litre of Roundup (R) to 100 litres of water. Apply at flowering stage. Beware of moisture stress.*

R. W. Applicators — *(Wiper Equipment)*

Roundup (R) herbicide now registered for use through Wiper Equipment. Rate 1 litre of Roundup herbicide to 2 litres water (33% solution). Roundup herbicide may be used according to directions for suppression or control of many annual and perennial weeds including

Rushes	*Cumbungi*
Johnson Grass	*Volunteer Sorghum*
Off-type sorghums	*Bracken Fern*

N.B. *Roundup may be used for weed control in agricultural land prior to establishing any edible or non-edible crop.*

Wiper Equipment

Spiedel Applicator

Multi Rope Wiper

Pipewick Wiper

Recommendations

1. *For most weeds, when using a Pipewick type of unit, a double pass is best.*
2. *A single pass with the Multi-Rope type of wiper is usually sufficient.*
3. *Speed of travel should be 3 - 6 kph*
4. *Aim to cover 5 - 10% of most plants.*
5. *Give new operators opportunity to gain experience in using wipers before main "season" commences.*
6. *Mix only enough herbicide solution for immediate use.*
7. *Use only clean water.*
8. *Do not store mixture in applicator.*
9. *Flush tank and wash ropes, etc., after use.*

Application of Velpar (R) Based Granuales By the Macspred (R) System

By G. A. Jacobs,
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The concept of weed control by the dry application of herbicide granules is not new; various formulations have been commercially available for over a decade. However, those herbicide granules contained only small amounts of active constituent, and the consequent necessity to apply them in high volumes combined with the lack of application equipment, rendered them unsuitable for large scale use.

The advent of Velpar (R) (hexazinone) based granules provided some answers to these problems. Velpar (R) is a highly active root absorbed soil residual herbicide. This coupled with the formulation of 200 g/kg hexazinone granules (Velpar (R) 20G and Dypar (R) 10/10G (100 g/kg hexazinone + 50 g/kg diuron + 50 g/kg bromacil granules), has overcome the drawback of having to apply large volumes of granules to effect satisfactory weed control. The advantage of not having to load, transport, store and distribute water is common to all granular herbicides, but the low volume and weight of Velpar (R) 20G required has allowed this benefit to be maximised.

Early testing of Velpar (R) based granules proved their excellent efficacy against a wide range of annual and perennial weed species under variable moisture, temperature and soil conditions. These tests have indicated that the overall performance of the granular formulation of Velpar (R) is at least equivalent to that of spray applications.

Uniform distribution and accurate placement of granules is just as essential as with spray applications. However, as equipment suitable for applying granules accurately over large areas was not available, granule application equipment was developed concurrently with Velpar (R) 20G and Dybar (R) 10/10G.

The use of new principles in the metering, distribution and placement of granules onto the target area was identified as the solution to the application problem. This led to the development of the Macspred (R) range of granule application equipment.

Based on the gravity drop of granules through a metering device into an airstream directed through distribution arms, the Macspred (R) evenly distributes the herbicide granules over the target area.

The Macspred (R) development was initially intended to improve the efficiency of weed control along railway lines. Some of the advantages of the Macspred (R) and Velpar (R) based granules in railway use are:-

1. *Application rates can be rapidly varied in relation to weed density and weed type.*
2. *Application rates can be rapidly varied across the swath width, e.g., the ballast (generally not as heavily weed infested) could be treated with a maintenance rate whilst the more dense growth in the cess may receive an application rate three or more times greater.*
3. *Application of different granular herbicide products can be made simultaneously to the ballast and to the cess.*
4. *The flow of granules can be rapidly cut-on and cut-off, thus allowing the economic spot-out operation.*
5. *There are no drift problems.*
6. *The ability to treat an area three or more times faster than is possible with a spray application is achieved through the reduced loading requirement and the ability to apply these granules at greater speeds with the Macspred (R).*
7. *The cost of the Macspred (R) is only 10 to 20% of the cost of a railway spray tanker capable of treating the same area.*

For railway applications future models of the Macspred (R) will have the option of automatic monitoring of flow rates and push button operation of "spot-out" applications.

The Macspred (R) principle has been developed to extend its usefulness to other areas e.g. sugar mill tram tracks, roadsides, firebreaks, and small areas around buildings, fences and tank farms.

The Macspred (R) is also being developed for incorporation of Velpar(R) based granules into the soil surface for weed control along road verges. This placement of the granules ensures they are retained in the target area, thus maximizing the weed control efficacy and minimizing off-target effects.

In conjunction with the continuing development of the Macspred(R) range, emphasis is being placed on maximizing the efficiency of the distribution of low application rates of two granule products currently available i.e. Velpar(R) 20G and Dybar(R) 10/10G. Use rates are currently 20 to 45 kg/ha for Velpar(R) 20G and 40-50 kg/ha for Dybar(R) 10/10G; the lower rates being applicable for the control of annual weeds. Trial work indicates that rates of 10 kg/ha and below may be satisfactory for seasonal weed control needs.

Investigations in granular usage are being carried out in some specific areas of brush control.

Granules now provide a novel, but effective approach to weed control. Their efficiency has been enhanced by the presence of Velpar(R); however it must be remembered that Velpar(R) has a detrimental effect on non-target species (trees). Therefore Velpar(R) based granules should not be applied closer than a distance equal to twice the height of the non-target species.

Brush Control with Velpar (R) L Applied by the Spotgun (R) Technique

By B. J. Horsfield, and C. F. Karlson,
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Test work conducted over several years, in many areas of Australia, has proven the efficacy of broadcast soil applied spray applications of Du Pont Velpar (R) Weedkiller against a wide range of brush and timber species. However, when only brush and timber were the target species, pasture damage was unacceptable.

Previous experience with Du Pont Hyvar (R) X-L Weedkiller demonstrated its efficacy against African Boxthorn ('Lycium ferocissimum') when applied as a liquid spot to the soil surface. In an endeavour to minimize pasture damage with Velpar (R) L this same liquid spot application technique is continually being evaluated for brush and timber control.

Along with evaluating the efficacy of Velpar (R) L applied as a small liquid spot directly to the soil, it was necessary to also develop a suitable applicator for the commercial viability of such a technique. The applicator, now marketed as the Du Pont Spotgun (R), is a specially designed hand held 'pistol like' device that delivers a pre-selected measured dose of Velpar (R) L.

The Spotgun (R) application of Velpar (R) L was initially evaluated against African Boxthorn, Sweet Briar ('Rosa rubiginosa') and Blackberry ('Rubus fruitcosus'). As a result 4 ml of Velpar (R) L per spot per plant up to 1 m high, was found to be consistently effective in controlling these brush species. This is now the recommended rate for Velpar (R) L.

The Spotgun (R) application technique depends on the uptake of Velpar (R) L by the root system of target species intercepting the column of Velpar (R) L moving through the soil from the surface applied liquid spot. A critical factor therefore is the placement of the liquid spot so that Velpar (R) L moves into the feeding root zone. With African Boxthorn,

the most efficacious results are obtained by placing the liquid spot half way between the base and the drip line.

However, for Sweet Briar and Blackberry, placement near the base of the stem, or crown respectively, has proved most efficacious.

Optimum results with Spotgun (R) application are obtained when the soil is moist at application, rainfall moves the Velpar (R) L into the soil and therefore the root zone, and when the target species is actively growing. Experience with Spotgun (R) applications of Velpar (R) L have shown that many species may go through two or more cycles of defoliation and refoliation before the plant finally dies.

The Spotgun (R) is supplied with an "on-surface" nozzle and a spear attachment. The spear attachment is used to inject Velpar (R) L below the soil surface. Experience has shown it is desirable to use the spear attachment when:-

(a) a dense ground cover prevents the Velpar (R) L being applied directly onto the soil surface.

(b) the target species is growing on sloping ground and there is a risk of the Velpar (R) L being washed down the slope from its optimum positioning.

Spotgun (R) applications have proved to be a most cost-efficient method of using Velpar (R) L for the control of brush and timber species. The Spotgun (R) technique causes a small patch of pasture damage at the point of application; however, this damage is temporary, disappearing in 12 to 18 months, depending on the site.

Further test work has continued with the Spotgun (R) and Velpar (R) L to establish its efficacy over a wide variety of brush and timber species to define recommendations related to their density and size, and placement of the liquid spot of Velpar (R) L. Specifically test work is being conducted to evaluate:-

(a) doses of 1 to 4 ml Velpar (R) L per spot.

(b) placement in relation to distance from the base of individual plants.

(c) number of shots of Velpar (R) L in relation to brush or tree size so as to establish a relationship between the number of shots and their height and/or basal stem diameter.

(d) various "grid" spacings and patterns for control of coppice.

(e) dose and spacing in relation to soil types and moisture levels.

(f) efficacy of "on-surface" versus sub-surface "spear" application techniques.

Some of the additional species with promising results on which this test work is being conducted include: Bimble Box/Poplar Box ('Eucalyptus populnea'), Coolibah ('E. microtheca'), Mallee ('E. socialis'/'E. dumosa'/'E.gracilis'), Queensland Blue Gum ('E. tereticornis'), Narrowleaf Ironbark ('E. crebra'), Broadleaf Ironbark ('E. fibrosa' ssp. 'fibrosa'), Yellow Box ('E. melliodora'), Dawson Gum ('E. cambageana'), Bloodwood ('Eucalyptus' ssp.), Brigalow ('Acacia harpophylla'), Prickly Acacia ('A. nilotica' ssp. 'indica'), Black Wattle ('A. cunninghamii'/'A. deanei'), Turpentine Bush ('Eremophila sturtii'), Emu Bush ('Eremocitrus glauca'), Narrow Leaf Hop Bush ('Dodonaea attenuata'), White Cypress Pine ('Callitris columellaris'), Tree of Heaven ('Ailanthus altissima'), Australian Blackthorn ('Bursaria spinosa'), Camphor Laurel ('Cinnamomum camphora'), Rubber vine ('Cryptostegia grandiflora'), 'Angophora' spp, and 'Tristania' spp.

On some of these species test work is also being conducted to evaluate the efficacy of Velpar (R) L as a stem injection treatment. This technique is also giving promising results and appears to have particular application in the control of timber species with stem diameters greater than 10 cm.

Indications to date from brush and timber control test work show that Velpar (R) L has efficacy against a wide range of species by either stem injection or Spotgun (R) application to the soil.

Note on Safety to Desirable Trees:

As Velpar (R) L controls trees too much emphasis cannot be placed on its use near desirable trees. While work is being conducted to provide further data, observations to date have shown the current "rule-of-thumb" remains in force, i.e., do not apply Velpar (R) closer than a distance equal to twice the height of the desirable tree.

Biological Control of Terrestrial Weeds

By Ernest S Delfosse
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Introduction

Biological control is one of the main procedures used to manage noxious or troublesome pests. It can be applied to insects, mites, vertebrates or plants, with the basic principles being similar for all types of target organisms. This paper will be restricted to a discussion of biological control of terrestrial plants which are considered by a particular interest group (i.e., local, State or Federal Government, farmer or grower groups, etc.) to be growing in the wrong place at the wrong time. We call such plants "weeds".

Biological control of weeds involves the use of relatively host-specific agents, which are intended to reduce the amount of weed present to below the level at which the weed is a problem (called the "economic threshold"). It should be noted that there is rarely only one economic threshold for a given weed species; different densities of the same weed can be tolerated depending upon the use(s) of the land. Thus, it is very important to determine, at a very early stage in the development of a program, that the plant is a weed in a given situation and that it is a significant enough pest (or potentially so) that biological control is merited. This is not as easy to establish as might be expected. Potential conflicts of interest should also be identified (and resolved, if possible) at an early stage.

Once a weed is determined to be significant enough to merit the time and expense of a biological control program, several items are often investigated. These include:

(1) Searching the literature for information about the origin of the weed, its distribution, and any potential agents for its biological control, including any which might already have been studied on

behalf of other countries.

(2) Visiting the centre of evolution (and other areas) of the weed to search for candidate agents (this can take several years).

(3) Making a "short list" of candidate agents for host-specificity testing.

(4) Testing the most promising candidate agents for their host range (i.e., determining the plant species which each candidate agent will eat, lay eggs on, complete development on, etc.; this can also take several years for each agent).

(5) Submitting written reports to the Department of Health for importation/release permits. This is done only for those candidate agents which the scientist feels, as a result of host-specificity testing and all other information at hand, are safe to introduce and are likely to be effective.

(6) Upon approval by Health, importing agents into Australia. Sometimes additional testing is required in quarantine (in which case a second report for successful candidates is submitted to Health, along with a request for a release permit), but often an import/release permit is issued. In either case, agents must be reared in quarantine for at least one generation before release in the field. The purpose of this initial rearing is to ensure that all "fellow travellers" (parasites, diseases or other species) are killed, and a pure culture of the agent is obtained.

(7) Mass-rearing, release and evaluation of the agent(s) in the field at pre-selected research sites. The evaluation phase is very important to understanding the reasons for agents becoming established, being effective, etc., or otherwise, and is normally conducted for many years.

Some other points are often considered in biological control of weeds programs. For example, whenever possible, agents are selected

from parts of their native distribution which are similar to areas in Australia where the plant is considered to be a weed ("climate matching"). Also, if several forms of the weed occur in the species' native distribution, and only one or a few forms occur in Australia, the Australian form is identified, and it is this form which is most intensively investigated in the native range of the weed.

In conclusion, biological control of weeds has several advantages over other types of control: it is permanent once agents are established, and thus requires little or no additional input; agents are self-disseminating, and can potentially spread throughout the Australian range of the weed; the agents are specific to a very restricted group of plants, all of which are very closely related to the target weed (some agents are specific to only one form of the weed species) - thus, biological control is safe and non-environmentally damaging; the cost:benefit ratios for successful programs are extremely cost-efficient; and biological control is a natural phenomenon, using regulation of weeds by their co-evolved, natural, biotic mortality agents.

Biological Control of Terrestrial Weeds

In Canberra, the CSIRO Division of Entomology is currently conducting research on five terrestrial weeds of Mediterranean origin: ragwort (Senecio jacobaea), skeleton weed (Chondrilla juncea), common heliotrope (Heliotropium europaeum), St. John's wort (Hypericum perforatum), and Paterson's curse/salvation Jane (Echium plantagineum; hereafter referred to as "Echium").

Ragwort This biennial (sometimes facultatively perennial) weed is restricted to Tasmania and high-rainfall areas of Victoria, with very limited occurrence in the Adelaide Hills, south western Western Australia and south eastern New South Wales. It is primarily a weed of dairy and beef cattle pastures, and contains pyrrolizidine alkaloids which sometimes cause considerable stock losses.

CSIRO is currently working on one species for biological control of ragwort, the flea beetle (Longitarsus jacobaeae). The beetle was first imported into Australia in 1977, and following additional host-specificity testing in quarantine in Canberra, was first released in the field in 1979. Two sites are under study: Gippsland, Victoria, and near Deloraine, Tasmania. The program is a co-operative venture between CSIRO, the Victorian Department of Crown Lands and Survey and the Tasmanian Department of Agriculture. The latter two agencies are also conducting their own rearing-release-evaluation programs.

Adults of'L. jacobaeae'feed on foliage of ragwort, but do not generally cause significant damage to the plant. Larvae of the beetle, however, tunnel in crowns of ragwort, and can kill plants directly or in combination with other stresses.

Although almost certainly established at both sites, present populations of the beetle are not large enough to cause significant damage to ragwort as yet.

Skeleton weed This is the longest-running of the current programs. There are three forms of this perennial weed in Australia: A (narrowleaf), B (intermediate-leaf) and C (broad-leaf).

In 1971 a form of the rust fungus, 'Puccinia chondrillina', specific to the narrow-leaf form was released. It quickly spread and killed much of the weed; this has been one of the most successful programs in the history of biological control of weeds. Forms of 'P. chondrillina' specific to the intermediate-leaf and broad-leaf forms of the weed are being investigated.

Other agents established in Australia for biological control of skeleton weed are the mite 'aceria chondrillae', the midge, 'Cystiphora schmidti', and the moth, 'Bradyrrhoa gilveolella'. While occasionally producing significant damage to the weed these agents are not as effective as the fungus. Interestingly, the mite shows a very high degree of form-specificity: it attacks the narrow-leaf form of

skeleton weed heavily, the intermediate-leaf form very little, and the broad-leaf form not at all. Prognosis for successful management of the remaining two forms of skeleton weed must be rated as very high.

Common heliotrope *Like ragwort (and 'Echium'; see below), this summer-growing annual weed contains pyrrolizidine alkaloids which can cause stock deaths. The weed occurs mainly west and north of the Great Dividing Range, largely within the 300-500 mm p.a., winter-dominant rainfall area, but also in South Australia, Western Australia and southern Queensland.*

The flea beetle, 'Longitarsus albineus', was first imported and released in 1979. Adults of this beetle feed on leaves, creating "shot-holes", while larvae feed on roots and cause the most damage to the plant.

Adults have been recovered near Jugiong, Urana and Corowa, New South Wales (at the release sites), and it is likely that the species is established at these sites, albeit at very low numbers. A further importation of this species occurred in 1982, and releases will hopefully be made at other sites in New South Wales and Victoria this season.

A second species, the weevil, 'Pachycerus madidus', was imported into quarantine for further host-specificity testing in 1982. Should the species prove safe to introduce, releases will be made as soon as possible. Adults of this weevil feed on foliage of common heliotrope, while larvae feed in the crown of the plant and cause the most damage.

Several other species, including insects and diseases, are known to attack the plant in its home range. Thus, long-term prospects for successful management of the weed must be rated as very good.

St. John's wort *This is one of the oldest programs in the history of biological control of weeds, having been started by CSIRO in the 1920's. Twelve species of insects were imported into Australia from 1929-53. Eight of these were released between 1930-55. Four of these, three*

beetles and one midge, became established. However, only the beetle, 'Chrysolina quadrigemina', has had significant impact on the weed in Australia. Thousands of hectares of this perennial weed have been eliminated by the beetle, sometimes in conjunction with pasture improvement. Larvae and adults of the beetle eat foliage of the plant.

In the current program (restarted in 1979), 'C. quadrigemina' and 'C. hyperici' have been re-imported and released at sites in New South Wales and Victoria. These new populations were selected from French areas which are eco-climatically similar to those areas where St. John's wort is still a problem in Australia.

New stocks of one of the four established species, the beetle, 'Agrilus hyperici', were imported and released in 1981. Adults are foliage feeders, and larvae feed in the crown of the plant. It is too early to guage the success of these releases.

Another species imported from 1932-9, but which did not become established in the field, is the foliage-feeding moth, 'Anaitis efformata'. This species was re-imported and released in 1981. It is again too early to predict the success of this species, but prospects are good.

Given the number of species which are known to attack St. John's wort in its home range, only some of which I have discussed here, their type of attack, etc., prognosis for management of the remaining areas of the weed in Australia must be rated as good.

'Echium' This winter-growing annual (sometimes facultatively biennial) weed is the subject of the most controversial program in the history of biological control of weeds. The weed occurs in all Australian States and Territories, but is most damaging in the Riverina areas of New South Wales and Victoria, and in South and Western Australia.

Four insects (three beetles and one moth) were approved for importation and release by Health. Only the moth 'Dialectica scalariella' was released in the field, at three sites in New South Wales (near Braidwood, Jugiong and Deniliquin).

An interim injunction to restrain releases was granted by the High Court based on an application by two apiarists and two graziers in July 1980. This led to a hearing before the Supreme Court of South Australia in late May/early June 1982. The case has not yet been resolved.

It is appropriate to discuss one point re the moth. Its failure to become established after the initial releases can in no way be construed as a negative finding about its possible control potential. The releases were small in number, experimental in purpose and took place in early winter. It is well-known that adult moths are killed by frosts, which occurred immediately after the releases, in its native range. (The species survives the winter period as larvae and pupae in leaves.) Thus, these were preliminary releases only, using small numbers of adults which were surplus to the mass-rearing program which was being conducted at that time. While it is not possible to predict just how effective the moth might be if released in large numbers at different times of the year, it can be stated with certainty that the moth has not yet had the chance to establish properly.

Should the case be resolved in favor of biological control, there are several additional species known to occur in the native range of the weed which appear to be specific and damaging. This complex of species attacks all parts of the weed. Thus, chances for successful management of the weed must be rated as good.

Discussion

The current projects cover summer-growing (common heliotrope) and winter-growing ('Echium'; occasionally a facultative biennial) annuals, a biennial which is often a facultative perennial (ragwort) and two perrenials (St. John's wort and skeleton weed). They also include sexually-reproducing, outbreeding species (common heliotrope, 'Echium' and ragwort) and apomicts (skeleton weed and St. John's wort). Weeds of crops (skeleton weed, and sometimes common heliotrope and 'Echium')

roadsides (all five species), and pasture and rangeland (all but skeleton weed) are also included. Perhaps the only common points among these weeds are that they are all very competitive, invasive, hervaceous, terrestrial weeds of Mediterranean origin! Chances of successful management of all five weeds are good to excellent.

In the following table are listed the weeds and agents discussed above.

WEED	AGENTS	
	SCIENTIFIC NAME	STATUS
Ragwort	Longitarsus jacobaeae	Probably established
Skeleton Weed	Puccinia chondrillina	Established against narrow-leaf form
	Aceria chondrillae	Established
	Cystiphora schmidti	Established
	Bradyrrhoa gilveolella	Established
Common heliotrope	Longitarsus albineus	Probably established
	Pachycerus madidus	Not yet released
St. John's wort	Chrysolina quadrigemina	*Established
	C. hyperici	*Established
	Agrilus hyperici	*Established
	Midge 'Zeuxidiplosis giardi'	Established
	Anaitis efformata	Status unknown
Echium plantagineum	Dialectica scalariella	Not established
	Beetle 'Longitarsus aeneus'	Not released
	Beetle 'L. echii'	Not released
	Beetle 'Phytoecia coerulescens)	Not released

* Unknown yet if new populations are also established.

Suggested Reading

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Biological Control of Aquatic Weeds

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Introduction

Biological control, which is one of several methods for reducing weed problems, has been defined by DeBach (1964, p 9) as "the study and utilization of parasites, predators, and pathogens for the regulation of host population densities". The first significant program for biological control of a weed was initiated in Hawaii against 'Lantana camara' in 1902. However, it was the outstanding success of the Australian program against prickly pear, 'Opuntia spp.', which began in 1920, that established biological control as an important method of weed control (Huffaker, 1971).

Biological control of a floating aquatic weed was first attempted in 1964 when a flea-beetle, 'Agasicles hygrophila', was liberated against alligator weed, 'Alternanthera philoxeroides', in the United States of America (Harley, 1977). This was followed, in 1972, by the liberation of insects for control of water hyacinth, 'Eichhornia crassipes' (Harley, 1982).

In this paper I shall discuss biological control of aquatic weeds in Australia, with particular reference to water hyacinth, alligator weed, 'Salvinia molesta' (salvinia) and 'Pistia stratiotes' (water lettuce).

Floating Aquatic Weeds in Australia

Australia has very few native floating aquatic plants and this niche has been filled by several aggressive, fast growing, introduced weeds. In many situations these weeds form a dense, almost impenetrable cover of the water surface causing major changes in the ecology of infested lakes and streams; impeding access to water for industrial, agricultural, pastoral and recreational purposes; increasing flood levels and consequent damage; and providing breeding sites for some disease vectors and nuisance mosquitoes (Mitchell, 1978).

Water hyacinth - The distribution of water hyacinth in Australia was documented by Mitchell (1978) and Forno and Wright (1981). Current infestations are mostly in coastal Queensland and New South Wales but there are small infestations in Northern Territory and Western Australia. Research directed at biological control of water hyacinth in Australia began in 1975 and in October of that year a weevil, 'Neochetina eichhorniae', was liberated (Harley 'et al.', 1978). This weevil is now widely established in Queensland and, to a lesser extent in New South Wales. The adults feed on the foliage making sub-circular pits 'ca' 2mm in diameter. The abundance of feeding scars is a good index of weevil activity, but it is tunnelling by larvae in the petioles and crown which severely damages water hyacinth plants. Tunnelling, and associated rotting and waterlogging of tissues, causes plants to float low in the water and may result in death. Under favourable conditions 'N. eichhorniae' may complete a generation in 'ca' three months (Harley and Wright, in press). In the field near Brisbane there are two, and sometimes a partial third, generations per year.

In October 1977, a second biological control agent, a pyralid moth, 'Sameodes albiguttalis', was liberated (Harley 'et al.', 1978) and is now widely established in Queensland and New South Wales. Larvae tunnel in the petioles of water hyacinth showing a preference for plants with bulbous or soft petioles. Rotting and waterlogging of plant tissues are again associated with attack. 'S. albiguttalis' may complete a generation in 'ca' 34 days (Harley and Wright, in press). In the vicinity of Brisbane, this moth breeds throughout the year.

A second moth, 'Acigona infusella', was liberated in September 1981 at two sites in south-east Queensland and one in north Queensland. More widespread distribution was not possible due to limitation of staff and resources. Initial breeding was observed following liberation but establishment has not been confirmed. Larvae of 'A. infusella' make large tunnels in the petioles, crown and rhizome of water hyacinth and De Loach (1975) evaluated it as being potentially the most effective biological control agent known. It may complete a generation in 'ca' 64 days.

Biological control agents have reduced the area of water hyacinth infestations in the more tropical parts of eastern Australia and further reductions are anticipated (Wright, 1981). However, plant type and rate of plant growth are influenced by factors other than temperature (e.g. nutrient levels and rate of water flow) and insect/plant interactions vary from one locality to another.

In New South Wales relatively low mean air temperatures may restrict the rate of population increase by the weevil, 'N. eichhorniae' and levels may, in fact, never reach those observed in warmer regions.

A major research program on the management and control of water hyacinth using biological agents both alone, and integrated with other control methods, is urgently required but cannot be mounted without a substantial increase in staff and resources. In the present economic climate these are most unlikely to be provided by CSIRO.

Alligator weed - The distribution of alligator weed in Australia was documented by Mitchell (1978) and Julien and Broadbent (1980). Infestations are confined to New South Wales but this weed has the potential to infest low-lying agricultural and pastural land, wetlands, dams, lakes and slowly flowing streams throughout much of the continent.

Research directed at biological control of alligator weed in Australia began in 1976 and in January 1977 a flea-beetle, 'Agasicles hygrophila', was liberated (Harley 'et al.', 1978). This beetle is now well established and very active during summer in infested areas near Sydney but is comparatively scarce and inactive in the Williamtown area. Adults and larvae feed on foliage and high populations can destroy floating alligator weed. Attack on terrestrial plants, or plants in wetlands which are only periodically submerged, is much less severe causing little damage (Julien, 1981). 'A. hygrophila' may complete its life cycle in 'ca' 25 days (Maddox, 1968).

In December 1977 a pyralid moth, 'Vogtia malloi', was liberated against alligator weed. Larvae tunnel inside stems causing wilting and death. The life cycle is completed in 'ca' 39 days (Maddox, 1970). This moth is well established but damage to alligator weed is masked by the more extensive damage caused by 'A. hygrophila'. In Australia 'V. malloi' may be more damaging to terrestrial alligator weed, where 'A. hygrophila' is relatively inactive (Julien, 1981).

Another flea-beetle, 'Disonycha argentinensis', was first liberated in February 1980 (Sands 'et al.', in press). Unlike 'A. hygrophila', this species is adapted to a terrestrial habitat. Additional liberations have been made and breeding observed in the field, but establishment has not been confirmed. Prospects for effective biological control of terrestrial alligator weed are not good.

Salvinia - The distribution of salvinia in Australia was documented by Mitchell (1978) and Harley and Mitchell (1981). Current infestations are mostly in coastal Queensland and New South Wales, with small infestations in Northern Territory and Western Australia, and two inland infestations near Mount Isa, Queensland. The weed almost certainly has the potential to grow in inland New South Wales with serious consequences for irrigated agriculture.

Research directed at biological control of salvinia in Australia began in 1978 and in June 1980 a weevil, 'Cyrtobagous singularis', was liberated on salvinia infesting Lake Moondarra, Mt. Isa. Control was rapid and successful with 8,000 tonnes of the weed being destroyed during the three months prior to August 1981 (Room 'et al.', 1981). Experimental liberations have now been made elsewhere in north Queensland and in Northern Territory. 'C. singularis' adults and larvae attack leaf buds and larvae tunnel in rhizomes. It may complete its life cycle in 'ca' 56 days (Harley and Sands, unpub. report 1979; Forno 'et al.', in press).

A pyralid moth, 'Samea multiplicalis', was liberated against salvinia in January 1981 at Mt. Isa and in February 1981 at Ingham, north Queensland. Establishment was rapid, and dispersal from Ingham to Home Hill, 200 km south, has occurred. Larvae severely damage the foliage of salvinia, but assessment of its ability to control this weed at Mt. Isa has been compounded by very heavy attack on the plant by 'C. singularis' and at Ingham by floodwaters flushing out infested plants. Monitoring of current infestations at Townsville and south to Home Hill may provide a better assessment of the potential of this control agent.

Laboratory studies and observations in the insect's native range in Brazil indicated that 'C. singularis' may be better adapted to a hotter climate and 'S. multiplicalis' to a cooler climate. It is possible that 'S. multiplicalis' may be the more effective agent in New South Wales, though the way it feeds on salvinia is not as damaging to the plant as 'C. singularis'.

To date these control agents have not been liberated elsewhere in eastern Australia because of a policy decision to first obtain more data on their interaction with 'S. molesta'. However, prospects for eventual biological control of this weed are good.

Water lettuce - The distribution of water lettuce in Australia was given by Aston (1973) and Sainty and Jacobs (1981). Current distribution is north coast of New South Wales, Queensland and Northern Territory. It occupies a similar habitat to water hyacinth and salvinia but is less aggressive (Sainty and Jacobs, 1981). A program of biological control began in 1978.

In March, 1982 a weevil, 'Neohydronomus pulchellus', was first liberated near Brisbane. Establishment has been good at this and at other sites, but it is too soon to evaluate the effectiveness of 'N. pulchellus' as a control agent. Adults and larvae feed on and in the foliage, promoting waterlogging and rotting. The life cycle is completed in 4 to 6 weeks (DeLoach 'et al.', 1976).

General Discussion

The rationale for these programs was that if water hyacinth, alligator weed, salvinia and water lettuce could all be brought under biological control, then we should not be faced with the problem of a reduction in one of these weeds being followed by an increase in another. These weeds all cause similar problems and replacement of one by another is no advantage. These species constitute all the major floating aquatic weeds in Australia and successful biological control should greatly assist in the return of lakes and streams to a condition approaching their pristine state.

To date no submerged weed has been the target of a biological control program in Australia. A complex of several species is often responsible for submerged weed problems and selective control of one may simply permit other species to increase and the problem would remain unresolved. Experience overseas indicates that selective control of one species may be difficult to achieve and that management of submerged weeds using more general feeders, such as the white amur fish, 'Ctenopharyngodon idella', is a more attractive proposition.

The long-term economics of biological control are excellent. In many situations biological control agents keep the target weed under control indefinitely, without further input. Agents are host specific and there are no unwanted side effects compared with control using herbicides.

We now have biological agents which will control water hyacinth, alligator weed, salvinia and water lettuce over much of their Australian ranges and we must develop strategies to maximise the impact of these agents and, where necessary, their integration into aquatic weed management systems.

Summary

Biological aquatic weed control in Australia is summarised in the following table:

Weed and Status	Agent	
	Name	Status
Floating weeds		
Water hyacinth	'Neochetina eichhorniae'	Established
Effective control	'Sameodes albiguttalis'	Established
in tropics	'Acigona infusella'	Establishment not confirmed
Alligator weed	'Agasicles hygrophila'	Established
Effective control	'Vogtia malloi'	Established
of floating weed	'Disonycha argentinensis'	Establishment not confirmed
Salvinia	'Cyrtobagous singularis'	Established
Effective control	'Samea multiplicalis'	Established
by 'C. singularis' at early experimental sites		
Water lettuce	'Neohydronomus pulchellus'	Established
Liberation of agent too recent for evaluation		
Submerged weeds		
No Australian programs		

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Example of Shire Council Policy Statement

for the Control of Noxious Weeds

1. *Council is required under the Local Government Act, to control and eradicate noxious weeds in the Shire from:*
   - *Council owned land.*
   - *Privately owned land including landowners and leasees.*
   - *Crown land on behalf of the State Government.*

2. *Council will submit an annual application to the Noxious Plants Advisory Committee for a N.S.W. Government Grant to supplement Council funds for noxious weed control work.*

3. *Financial resources for noxious weed control are limited, so Council will:*
   - *aim to obtain maximum landholder co-operation and participation in the effective implementation of the weed control programme.*
   - *Council will place great emphasis on those weeds that are likely to cause greatest economic loss either because of their widespread presence, or, ability to spread rapidly.*

4. *The major problem noxious weeds in the Shire are:- (listed in order of priority).*

   i.e.
   - *Serrated Tussock*
   - *Blackberry*
   - *St.John's Wort*
   - *Nodding and Scotch Thistles*
   - *African Love Grass*

   (This list will vary from Council to Council).

RESOURCES

Weed Inspectors

At present time Council employs Noxious Weeds Inspectors, whose duties are to:

* *inspect properties and all land under Council control with a view to locating infestation of noxious plants.*
* *prevent the spread of noxious plants and reduce existing infestations as required under the Local Government Act.*
* *to implement Council's noxious weed control programme.*
* *to alert Council of any significant changes in the noxious weed situation in the Shire.*
* *liaise with officers of the Department of Agriculture.*

Council policy with regard to these inspectors will be as follows-

* *Two Inspectors will primarily be employed full time on property inspections.*
* *One Inspector will primarily carry out private contract work with the assistance of a casual labourer.*
* *The fourth Inspector will carry out the control of noxious weeds on Council property, roads, etc.*

Equipment

Council has the following equipment. THESE ARE AVAILABLE ON A BREAK EVEN COST BASIS for carrying out work on private land. Contact Council's Chief Weeds Officer ( ) for further information.

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_____

_____

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Chemical

Council will supply registered chemicals for noxious weed control at Council's bulk purchase price plus a small handling fee.

WORK METHODS

The following guidelines have been agreed to by Council.

1. *Inspections - Notices - Classification*

1-1 *Council's method of implementing noxious plant control will be by advising by letter after the first inspection, the presence of specific weeds on the property and stating a reasonable period of time and area for control methods to be implemented.*

1-2 *If the subsequent inspection shows no action has been taken, a notice under Section 473 of the Local Government Act will be served.*

1-3 *Failure to comply with this notice will result in Council instituting legal proceedings for non-compliance and/or the issue of a notice under Section 474 of the Local Government Act after which Council will enter onto the property and carry out the work at the landowner's expense.*

1-4 *It is proposed that as inspections are carried out, the property files will be designated into one of three categories.*

* *Red: heavily infested*
* *Orange: medium infestation*
* *Green: light (scattered) or no infestation*

With files and property maps, which will be similarly marked, it will be easy to recognise problem areas and evaluate the best method of achieving effective noxious weed control

Landholders are invited to contact Council regarding noxious weed classification and control options.

2. *On-Farm*

2-1 *Noxious weeds are not controlled by haphazard use of chemicals nor with an ineffective whole farm plan.*

Council will aim to progressively reduce noxious weeds by the active co-operation and participation of landholders in the development of practical, reasonable and effective whole farm plans for noxious weed control.

2-2 *Where a property has a large infestation that could not be economically treated in one year, Council's Weeds Officer(s) will, in consultation with the landowner, establish a plan to deal with the infestation over a number of years.*

2-3 *Initially, a base area would be agreed to and cleaned up of noxious weeds. The next season, the same area must be treated for re-infestation, and a further section of the property treated. This system would then continue until the entire property was free of noxious weeds.*

2-4 *The Department of Agriculture recommends that the most positive and economic long term results can be achieved by cleaning up light, scattered infestation first and then contain large dense infestation by treating the perimeters until work can be commenced on the base infestation.*

3. *Weed Free Areas*

Where inspections identify key areas of noxious weeds or where landholders, by their own initiative are agreeable (in a similar way to the rabbit free areas, supervised by the Pastures Protection Board) then:

* *a group of properties will be selected and an overall and individual control programme will be developed to obtain noxious weed control free areas.*

4. *Technical Advice*

Councils' Weeds Inspectors can assist by advising landholders of the best methods of treatment to suit each infestation, e.g., cultivation, pasture or chemical means. Staff are in regular contact with the N.S.W. Department of Agriculture, regarding latest recommended control measures. (For serrated tussock control concessional finance is available to eligible landholders. Contact Council, the District Agronomist or your nearest State Bank for further details).

5. *Weed Control Programme*

The Chief Weeds Officer will draw up a yearly programme and time-table for inspections and the spraying of various weeds. This timetable should be flexible to fit in with the seasonal changes and weather conditions. The programme will be submitted to Council for approval before implementation.

SECOND BIENNIAL NOXIOUS PLANTS CONFERENCE

INNOVATIVE IDEAS COMPETITION

RULES:

* *Idea must be practical and labour saving, easy to use and apply.*

* *Must be innovative.*

* *Can be used by Weeds Officers in general.*

* *Can be anything or idea applicable to noxious plant control.*

A perpetual shield donated by Dupont Australia Ltd., Agricultural Divisions, will be held by the winning council for the next two years. An individual prize will go to the Weeds Officer.

INNOVATIVE IDEAS COMPETITION ENTRIES

APRIL, 1983

1.	*Wellington Shire Council*	*Rope Wick Applicator*
2.	*Central Northern County Council*	*Bond folder for maps*
3.	*Central Northern County Council*	*Roadside pasture seeder*
4.	*Far North Coast County Council*	*Diesel motors*
5.	*Snowy River Shire Council*	*5 way mixing and filling pump*
6.	*Scone Shire Council*	*Nozzle adaption for spot gun*
7.	*Mulwarree Shire Council*	*Noxious plant policy*
8.	*Port Stephens Shire Council*	*Electrical adjustment of spray nozzle*
9.	*Wangecarribee Shire Council*	*Removeable spray body*
10.	*Hay Shire Council*	*Cover for vehicle window.*
11.	*Mid Western County Council*	*Weed competition*
12.	*Jerilderie Shire Council*	*Map and weed information holder*

AWARD WINNERS

Dupont Shield	*Hay Shire Council*
	(Vehicle Window Cover)
N.P.A.C. Award	*Central Northern County Council*
	(Bond Folder for Maps)
Inkata Press Awards	*Port Stephens Shire Council*
	(Electrical Adjustment of Spray Nozzle)
	Mid Western County Council
	(Weed Competition for Schools)

REGISTER OF ATTENDANCE

DELEGATES

PART 1

AKEHURST, N.R., Neville	W/O	Far North Coast County Council
AJANI, J.A., Jeff	Inspector	Prickly Pear Destruction Commission
ALCHIN, B., Bruce	Exec. Asst.	Western Lands Comm., Sydney
ANDERSON, R., Rob	Manager	Monsanto Aust. Ltd., Tamworth
ANDREWS, D., David	Ord. Off.	Bland Shire, West Wyalong
ANDREWS, F., Fred	W/O	Nambucca Shire, Bowraville
ARMSTRONG, W.D., Don	C.W.O.	Far North Coast County Council, Casino
ARMSTRONG, T., Trevor		Alan Fletcher Res. Stn., Sherwood, Qld
ASHTON, D. Dennis	P.C.O.	Sydney Water Board, Sydney
ATHERDEN, F.B., Fred	Engr. Asst.	S.R.A., Narrabri
ATLEY, J., Jack	C.W.O.	Central Murray County C., Deniliquin
BAILEY, M.F., Max	County Clerk	Far North Coast County C., Casino
BAKER, H. Harvey	Snr. Chemist	Dept. Agriculture, Rydalmere
BAKER, R.W., Ron	Snr. W/O	Narrabri Shire, Narrabri
BANCROFT, J., John	W/O	Wyong Shire, Wyong
BARHAM, A., Alan	Divn. Engr.	S.R.A., Tamworth
BASTOCK, D., Don	D/City Engr.	Shoalhaven City, Shoalhaven
BEGG, C., Col	R.P.O.	Dept. Agriculture, Gunnedah
BELL, D., Des	Rep.	Dow Aust. Ltd., Tamworth
BOYAN, J., Jim	W/O	Wingecarabee Shire, Moss Vale
BREMNER, R., Ray	CR	Crookwell Shire, Crookwell
BRITTON, J., John	Dist. Agron.	Dept Agriculture, Gloucester
BROWN, D., Derek	F/O (W)	Dept. Agriculture, Tamworth
BUSBY, J., John	Rep.	Ciba-Geigy, Armidale
BUSH, G., Gil	W/O	Yass Shire, Yass
BUNN, K., Ken	W/O	Port Stephens Shire, Raymond Terrace
BRYANT, M., Mike	Economist	Dept. Agriculture, Gunnedah
CAMPBELL, L., Lindsey	Inspr(Pstcds)	Dept. Agriculture, Wollongbar
CAMPBELL, M., Malcolm	Snr Res. Scnt.	Dept. Agriculture, Orange
CASHEN, W.M., Wayne	W/O	Merriwa Shire, Merriwa
CHAPMAN, J., John	Scntfc. Off	Pollution Control Comm., Sydney
CHARLTON, B., Brian	Civ. Engr.	Willow Tree
CHEETHAM, R., Robbie	W/O	Central Murray County C., Deniliquin
CHERRY, J.E., Jim	C.W.O.	Central Nrthn. C. Council, Quirindi
CLINTON, D., Don	W/O	Snowy River Shire, Berridale

COFFEY, W., Bill	W/O	Dubbo City Council, Dubbo
COLWILL, E.G., Jock	W/O	Temora Shire, Temora
COLLYER, G.D., Greg	W/O	Gunnedah Shire, Gunnedah
CONE, L.C., Lionel	W/O	Coonabarabran Shire, Coonabarabran
CONE, P., Peter	Inspr(Pstcds)	Dept. Agriculture, Gunnedah
CORCORAN,D., Des	W/O	Boorowa Shire, Boorowa
COX, T.F., Tom	W/O	Wollongdilly Shire, Picton
CROKER, E., Eric	W/O	Crookwell Shire Council, Crookwell
DALEY, J.G., Jack	C.W.O.	Hawkesbury Rvr. C. Council, Castle Hill
DARLINGTON, S., Steve	Surveyor	Bourke Shire, Bourke
DELFOSSE, E.S., Ernest	Snr. Res. Scnt.	CSIRO, Canberra
DELLOW, J., Jim	Spl. Agron. (W)	Dept. Agriculture, Orange
DENT, I.K., Ian	W/O	Dungog Shire, Dungog
DICKMAN, S., Steve	W/O	Wingecarabee Shire, Moss Vale
DONNELLY,L., Len	Shire Pres.	Severn Shire, Glen Innes
EAGLESTONE, E., Ted	W/O	Cabonne Shire, Molong
EBERT, D., Doug	W/O	Wagga City Council, Wagga
ELLIS, I.W., Warren	W/O	Gloucester Shire, Gloucester
EVANS, C., Chris	Rep.	Monsanto Australia, Narrabri
EVERY, W., Bill	CR	Severn Shire, Glen Innes
FAGAN, R., Rob	Rep.	DuPont Australia Ltd., Tamworth
FAVIELL, M.I., Ian	W/O	Tallaganda Shire, Braidwood
FEEZ, A., Anthony	Res. Agron.	Dow Australia Ltd., Sydney
FENEMORE, P.J., Peter	L'scape Off.	D.M.R., Sydney
FENN, K., Kel	Rep.	Ciba-Giegy Ltd., Gunnedah
FITZGERALD, J., John	W/O	New Eng. Tblands County C., Armidale
GAITER, J., Jack	W/O	Tenterfield Shire, Tenterfield
GEORGES, J., Joe	Chairman	New Eng. Tblands County C., Armidale
GOLLAND, H., Harold	Shire Pres. Shire Rep.	Quirindi Shire, Quirindi Noxious Plants Adv. Committee, Sydney
GORHAM, P., Peter	F/O (W)	Dept. Agriculture, Cowra
GRAHAM, P., Phil	Snr. Engr.	Dubbo City Council, Dubbo
GRAY, P., Peter	F/O (W)	Dept. Agriculture, Dubbo
GREEN, H.G., Glen	Engr. Asst.	S.R.A., Dubbo
GREENUP, P.L., Lawrie	Director	Pesticides & Env. Studies, Dept Agri, Sydney
GREGORY, E.R., Ed	W/O	Hay Shire Council, Hay

HILL, K.R., Ken	Ald.	Tamworth City Council, Tamworth
HALLIDAY, E.D., Esther	Ald.	Tamworth City Council, Tamworth
HANSEN, F., Frank	Snr. Det.Cons.	N.S.W. Police Force, Sydney
HARDY, J.W., John	W/O	Maclean Shire, Maclean
HARLEY, K.L.S., Ken	Scientist	C.S.I.R.O., Brisbane, Queensland
HARTLEY, D., David	Dr. Adv.Serv.	Dept Agriculture, Gunnedah
HAYES, K.N., Ken	W/O	Coffs Harbour Shire, Coffs Harbour
HAYS, R., Dick	CR.	Far North Wstrn. Slopes County C. Warialda
HERRON, N.D., Neil		Stock Routes & Rur. Lands Brd., Brisbane
HILLIER, D.J., Dennis	W/O	Gunning Shire, Gunning
HOAD, J., John	W/O	Grafton City Council, Grafton
HODGES. C., Col	Fed.	Mun. & Shire Council Emp. Union, Sydney
HONEYMAN, R., Dick	W/O	Jerilderie Shire, Jerilderie
HORSFIELD, B., Bernie	Rep.	DuPont Aust. Ltd., Brisbane, Qld.
HOSKINGS, J., John	Entnemologist	Prickly Pear Dest. Comm., Tamworth
HOWIE, B., Bruce	Res.Agron.	Roche-Maag Aust. Ltd., Bankstown
HUTHNANCE, P.E., Peter	Shire Clerk	Forbes Shire, Forbes
JACOBS, G., Geoff	State Supvr.	DuPont Aust. Ltd., Sydney
KARLSON, C., Col		DuPont Aust. Ltd., Sydney
KAYE, R.A., Andrew	Solicitor	Quirindi
KERRISON, J.R., John	W/O	Harden Shire, Harden
KNOWLES, G.H., George	Dr-General	Dept Agriculture, N.S.W., Sydney
KNOX, J.R.H., Joe	W/O	Urana Shire, Urana
LAUNDERS, T., Terry	Res. Agron.	Department Agriculture, Taree
LAWLER, A., Tony	W/O	Muswellbrook Shire, Muswellbrook
LAWLER, J., Jack	Cr.	Severn Shire, Glen Innes
LEECH, R., Bob	N.P.C.	Snowy River Shire, Berridale
LEGGAT, R.W., Bob	Ranger	Nat. Parks & Wldlife Serv., Armidale
LEITCH, D., David	Rep.	Roche-Maag Aust. Ltd., Coffs Harbour
LEWINS, B.N., Bruce	Hlth/Surv.	Tenterfield Shire, Tenterfield
LEWIS, V., Vern	Chairman	Far North Wstrn. Slopes C.C., Warialda
LEVETT, J., Judith	Res. Asst.	U.N.E., Armidale
MARCINIAK, A., Alex	W/O	Maitland City Council, Maitland
MARSHALL, R.E., Bob	W/O	Camden Municiapl Council, Camden
MASON, C.F., John	C.W.O.	Far North Wstrn. Slopes C.C., Warialda
MATHEWS, G., Graham	W/O	Belligen Shire, Belligen
McCARTHY, J.P., John	Cr.	Hardne Shire, Harden
McCLOY, K., Keith	Prin(Rem.Sens)	Dept Agriculture, Sydney
McDONALD, W.J., Warren	Sp.Agrn.(Pstrs)	Dept Agriculture, Tamworth
McDONALD, S., Steve	Snr. Surv.	Dept. of Lands, Tamworth
McGIRR, R., Ray	Rep.	NuFarm Chemicals Ltd., Tamworth

McKENZIE, A.C., Sandy	Chairman	Upper Macquarie County Council, Kelso
McHARG, R., Roy	Hlth. Surveyor	Severn Shire, Glen Innes
McLELLAN, A., Tony	East Coast Helicopters P/L, Caloundra, Queensland	
McLENNAN, A., Alex	Agronomist	S.R.A., Sydney
McMILLAN, M., Max	Sp.Agron.(Weeds)	Dept Agriculture, Glen Innes
MONEY, R.K., Roger	Parks Supervisor	Armidale City Council, Armidale
MILNE, B., Barney	F/O (Weeds)	Dept Agriculture, Orange
MILVAIN, H., Hugh	F/O (Weeds)	Dept Agriculture, Leeton
MULVAINY, P., Peter	W/O	New Eng. Tblands C.C., Armidale
MUNDAY, H., Howard	Ranger	Pasture Protection Board, Armidale
MURPHY, A., Alan	Snr. Res.Agron.	Dow Aust. Ltd., Sydney
MURRAT, A., Andy	W/O	Castlereagh/Macquarie C.C., Walgett
NALDER, R., Ron	C.W.O.	Cabonne Shire, Molong
NEESON, M.L., Mark	W/O	Leeton Shire, Leeton
NEILSON, P., Peter	Rep.	Bayer Aust. Ltd., Quirindi
NICHOLS, K.G., Kerry	Eng. Off.	Singleton Shire, Singleton
OHLBACK, B., Brian	C.W.O.	Mulwaree Shire, Goulburn
OLIVE, M.J., Malcolm	Chairman	Far North Coast C.C., Casino
O'MALLEY, A.C., Charles	W/O	Narromine Shire, Narromine
PAGE, N.T., Norm	Cr.	Copmanhurst Shire, Grafton
PALMER, C., Col	Eng. Asst.	S.R.A., Tamworth
PARSONS, D., Dallas	Dist. Agron.	Dept. Agriculture, Moree
PAYNE, R.R., Ron	Land Insp.	Dept. Lands, Armidale
PEARCE, H.H., Hugh	W/O	Upper Macquarie C.C., Kelso
PENDERED, W.B., Bill	W/O	Singleton Shire, Singleton
PERKINS, J.H.W., John	W/O	Far North Coast C.C., Casino
PERKINS, T., Tim	Rep.	NuFarm Chemicals Ltd., Sydney
POULTER, J., Joe	Secretary	Noxious Plants Adv. Comm., Sydney
QUELCH, C., Charlie	Cr.	Far North Wstrn Slopes C.C., Warialda
QUINLAN, N.B., Barry	Pks. Supv.	Orange City Council, Orange
RATHORE, A.D., Ashok	Dr.	Nat. Parks & Wldlife Serv., Sydney
REECE, B., Bryson	W/O	Forbes Shire, Forbes
REDMAN, B.R., Bruce	Shire Eng.	Gloucester Shire, Gloucester
REKO, T., Tom	W/O	Carrathool Shire, Goolgowi
REID, K., Kevin	W/O	Weddin Shire, Grenfell
REED, T.A., Tom	W/O	Orange City Council, Orange
RICHARDS, J.H., Jack	P/O	Bogan Shire, Nyngan
RICHARDSON, P., Peter	W/O	Castlereagh Macquarie C.C., Walgett

RITCHIE, N.R., Norm	W/O	Gtr. Taree City Council, Taree
ROBERTS, R., Ron	W/O	New Eng. Tblands. C.C., Armidale
ROBINSON, R., Bob	W/O	Yarrowlumbla Shire, Queanbeyan
ROBERTSON, R., Ross	Rep.	Roche-Maag Aust. Ltd., Bankstown
ROSEWARNE, J., John	W/O	Queanbeyan City Council, Queanbeyan
RUSSELL, A., Alan	Barrister	Dept. Agriculture, Sydney
RYAN, E.R., Garry	Commissioner	Prickly Pear Dest. Comm., Tamworth
RYAN, W.L., Bill	C.W.O.	Mid-Western C.C., Mudgee
SAINSBURY, G.T., George	W/O	Junee Shire, Junee
SAMUELS, W., Wal	W/O	Wellington Shire, Wellington
SCOTT, J., John	Manager	Roche-Maag Aust. Ltd., Tamworth
SHELTON, K., Keith	W/O	Central-Murray C.C., Deniliquin
SHILSTON, D., David	Tech. Asst.	S.R.A., Katoomba
SHORT, R., Ron	Hlth. Surveyor	Bellingen Shire, Bellingen
SLACK-SMITH, R., Ross	C.W.O.	Castlereagh-Macquarie C.C., Walgett
SMITH, L.W., (Dr), Leon	P.Agron.(Weeds)	Dept Agriculture, Sydney
SMITH, A.W., (Dr), Alan	Reg.Director	Dept. Agriculture, Gunnedah
SOMERVILLE, J., James	W/O	Gundagai Shire, Gundagai
SPONG, A.J., Joe	W/O	Warool Shire, Moulamein
STEINHAEUSER, M., Mike	W/O	Cooma-Manaro Shire, Cooma
STEWART, G., Graham	Surveyor	Dept. of Lands, Armidale
STORES, G., Greg	State Mgr.	Roche-Maag Aust. Ltd., Bankstown
STRAUGHAN, N., Nevill	Tech.Off.(Weeds)	Dept Agriculture, Glen Innes
SUTTON, J., John	W/O	Young Shire, Young
SUTTON, N., Nigel	Engr.	Kiama Municiapl Council, Kiama
SWAIN, R.W., Roy	W/O	Central-Northern C.C., Quirindi
TANNER, L.R., Les	Snr. Insp.	Prickly Pear Dest. Comm. Bingara
THWAITES, D., Des	Mngment. Contnt.	Des Thwaites & Assts., Sydney
TURNER, K., Ken	W/O	Cabonne Shire, Molong
VANDERVELDE, T., Tom	W/O	Far North Westrn. Slopes C.C., Warialda
VARLEY, J.F., John	Hlth. Surveyor	Glen Innes Municipal Council, Glen Innes
VICKERY, D., Doug		Gosford City Council, Gosford
WALKER, R., Richard	Dist. Agron.	Dept Agriculture, Wellington
WATERS, K., Kevin	C.W.O.	New Eng. Tblelands C.C., Armidale
WEBB, R., Cec	C.W.O.	Wellington Shire Council, Wellington
WHALE, B.G., Ben	W/O	Copmanhurst Shire, Grafton
WHITE, A.E., Albie	W/O	Bombala Shire, Bombala

WHITLEY, J.E., Jack	W/O	Scone Shire, Scone
WILLIS, D., Don	Pks. Supv.	Tamworth City Council, Tamworth
WILLMOT, C., Clive	W/O	Moree Plains Shire Council, Moree
WILSON, E., Ed	Chairman	Central-Northern C.C., Quirindi
WOODS, K., Kevin	W/O	Carrathool Shire, Goolgowi
WRIGHT, O., Owen	Dir. (P.P.Brd)	Noxious Plants Adv. Comm., Sydney
YEOMANS, I.C., Ian	W/O	Lachlan Shire, Condobolin
YOUNG, R., Bob	Cr.	New Eng. Tablelands C.C., Armidale

PART TWO

REGISTER OF ATTENDANCE

ADDRESSES

GOVERNMENT DEPARTMENTS

AGRICULTURE

Cowra. 2794	P.O. Box 129	Ph. 063 - 422122
Dubbo. 2830	P.O. Box 865	Ph. 068 - 825100
Glen Innes. 2370	Agricultural Res. Stn.	Ph. 067 - 321633
Gloucester. 2422	P.O. Box 108	Ph. 065 - 581426
Gunnedah. 2380	P.O. Box 546	Ph. 067 - 429200
Leeton. 2705	P.O. Box 540	Ph. 069 - 533811
Moree. 2400	P.O. Box 209	Ph. 067 - 522488
Orange. 2800	Forest Road	Ph. 063 - 636700
Rydalmere. 2116	P.M.B. 10 P.O.	Ph. 02 - 6300251
Sydney. 2000	P.O. Box K220, (McKell Bldng. Rawson Plc)	Ph. 02 - 2176666
Tamworth. 2340	P.O. Box 547	Ph. 067 - 672325
	F/O(W) A.H.	Ph. 067 - 679342
Taree. 2430	P.O. Box 253	Ph. 065 - 522444
Wollongbar. 2480	Agricultural Res. Cen.	Ph. 066 - 297511

LOCAL GOVERNMENT AND LANDS

Armidale (Lands Office) 2350	P.O. Box 199A	Ph. 067 - 722308
Sydney. 2000 Caga Centre,	8-18 Bent Street	Ph. 02 - 2404449
Tamworth. 2340 (Lands Office)	P.O. Box 535	Ph. 067 - 661988

MAIN ROADS (D.M.R.)

Sydney. 2000	P.O. Box 198, Haymarket	Ph. 02 - 2186888

NATIONAL PARKS AND WILDLIFE SERVICE

Armidale. 2350	P.O. Box 402	Ph. 067 - 721733
Sydney. 2000	189-193 Kent Street	Ph. 02 - 2376500

POLICE DEPARTMENT

Sydney. 2001	G.P.O. Box 45	Ph. 02 - 3390277

POLLUTION CONTROL COMMISSION

Sydney. 2001	G.P.O. Box 4036	Ph. 02 - 2660661

PRICKLY PEAR DESTRUCTION COMMISSION

Bingara. 2404	P.O. Box 1	Ph. 067 - 241616
Tamworth. 2340	P.O. Box 643	Ph. 067 - 672312

STATE RAIL AUTHORITY

Cootamundra. 2590	Hovell Street	Ph. 069 - 4212
Dubbo. 2830	Talbragar Street	Ph. 068 - 821157
Katoomba. 2780	P.O. Box 210	Ph. 047 - 821378
Narrabri. 2390	Logan Street	Ph. 067 - 922363
Sydney. 2000	11-31 York Street	Ph. 02 - 2904456
Tamworth. 2340	Brisbane Street	Ph. 067 - 662214

SYDNEY WATER BOARD

Sydney. 2000	P.O. Box A53	Ph. 02 - 2660266

WESTERN LANDS COMMISSION

Sydney. 2001	G.P.O. Box 4351	Ph. 02 - 20529

C.S.I.R.O.

Brisbane, Queensland	Private Bag No.3 P.O. Indooroopilly. 4068	Ph. 07 - 3713322
Canberra, A.C.T. 2601	P.O. Box 1700, City	Ph. 062 - 464911

UNIVERSITY OF NEW ENGLAND

Armidale. 2351	Dept. Agronomy & Soil Sci.	Ph. 067 - 732829

QUEENSLAND

Brisbane. 4000	Stock Routes & Rur. Land Protection Board, P.O. 168	Ph. 07 - 224829
Sherwood. 4075	Alan Fletcher Res. Stn. P.O. Box 36	Ph. 07 - 279611

LOCAL GOVERNMENT

COUNTY COUNCILS

Castlereagh-Macquarie	P.O. Box 31, Walgett 2385	Ph: 068 - 281337
Central Murray	P.O. Box 60, Deniliquin 2710	Ph: 058 - 812422
Central Northern	P.O. Box 115, Quirindi 2343	Ph: 067 - 461755
Far North Coast	P.O. Box 378, Casino 2470	Ph: 066 - 622396
Far North Western Slopes	P.O. Box 93, Warialda 2402	Ph: 067 - 2922/16
Hawkesbury River	P.O. Box 75, Castle Hill 2154	Ph: 02 - 6342200
Illawarra	P.O. Box 264, Bowral 2576	Ph: 042 - 287511
Mid-Western	P.O. Box 138, Mudgee 2850	Ph: 063 - 721944
New England Tablelands	P.O. Box 94, Armidale 2350	Ph: 067 - 722361
Upper Macquarie	7 Lee Street, Kelso 2795	Ph: 063 - 314200

SHIRE COUNCILS

Bellingen	P.O. Box 117, Bellingen 2454	Ph: 066 - 551027
Bland	P.O. Box 21, West Wyalong 2671	Ph: 069 - 7212/824
Bogan	P.o. Box 221, Nyngan 2825	Ph: 068 - 3235/577
Bombala	P.O. Box 105, Bombala 2553	Ph: 0648 - 83555
Boorowa	P.O. Box 96, Boorowa 2586	Ph: 063 - 853303
Bourke	P.O. Box 21, Bourke 2840	Ph: 722055
Cabonne	P.O. Box 17, Molong 2866	Ph: 063 - 6932/30
Carrathool	P.O. Box 12, Goolgowi 2677	Ph: 069 - 6511/6
Coffs Harbour	P.O. Box 155, Coffs Harbour 2450	Ph: 066 - 522555
Cooma-Monaro	P.O. Box 714, Cooma 2630	Ph: 0648 - 21177
Coonabarabran	P.O. Box 191 Coonabarabran 2847	Ph: 068 - 421944
Copmanhurst	P.O. Box 434, Grafton 2460	Ph: 066 - 422855
Crookwell	P.O. Box 10, Crookwell 2625	Ph: 048 - 321022
Dungog	P.O. Box 95, Dungog 2420	Ph: 049 -
Forbes	P.O. Box 333, Forbes 2871	Ph: 068 - 521233
Gilgandra	P.O. Box 23, Gilgandra 2827	Ph: 068 - 472709
Great Lakes	P.O. Box 450, Forster 2428	Ph: 065 - 546277
Gloucester	P.O. Box 11, Gloucester 2422	Ph: 065 - 5711/11
Gundagai	P.O. Box 34, Gundagai 2722	Ph: 069 - 441266
Gunnedah	P.O. Box 63, Gunnedah 2380	Ph: 067 - 420422
Gunning	P.O. Box 42, Gunning 2581	Ph: 048 - 451312
Harden	P.O. Box 110, Harden 2587	Ph: 063 - 862305
Hay	P.O. Box 141, Hay 2711	Ph: 069 - 9331/33
Jerilderie	P.O. Box 9, Jerilderie, 2716	Ph: 058 - 851200

Junee	P.O. Box 93, Junee 2593	Ph: 069 - 241766
Lachaln	P.O. Box 216, Condobolin 2877	Ph: 068 - 952377
Leeton	P.O. Box 394, Leeton 2705	Ph: 069 - 532611
Maclean	P.O. Box 6, Maclean 2463	Ph: 066 - 452266
Merriwa	P.O. Box 63, Merriwa 2329	Ph: 065 - 482109
Moree Plains	P.O. Box 420, Moree 2400	Ph: 067 - 529211
Mullwarre	P.O. Box 148, Goulburn 2580	Ph: 048 - 211933
Nambucca	P.O. Box 51, Gowraville 2449	Ph: 065 - 647106
Narrabri	P.O. Box 261, Narrabri 2390	Ph: 067 - 921233
Narromine	P.O. Box 115, Narromine 2821	Ph: 068- 891322
Parkes	P.O. Box 337 , Parkes 2870	Ph: 068 - 621011
Port Stephens	P.O. Box 42, Raymond Terrace 2324	Ph: 049 - 873122
Scone	P.O. Box 208, Scone 2337	Ph: 065 - 451466
Severn	P.O. Box 256, Glen Innes 2370	Ph: 067 -
Singleton	P.O. Box 314, Singleton 2330	Ph: 065 - 721866
Snowy River	Myack Street, Berridale 2628	Ph: 0648 - 63251
Tallagandra	P.O. Box 91, Braidwood 2622	Ph: 048 - 422225/225
Temora	P.O. Box 164, Temora 2666	Ph: 065 - 522744
Tenterfield	P.O. Box 214, Tenterfield 2372	Ph: 067 - 361744
Urana	P.O. Box 123, Urana 2645	Ph: 069 - 2085/25
Wade	P.O. Box 485, Griffith 2680	Ph: 069 - 621277
Wakool	P.O. Box 40, Moulamein 2739	Ph: 058 - 8741/7
Weddin	P.O. Box , Grenfell 2810	Ph: 063 - 431156
Wellington	P.O. Box 62, Wellington 2820	Ph: 068 - 452099
Wingecaribee	P.O. Box 141, Moss Vale 2577	Ph: 048 - 911066
Wollondilly	P.O. Box 21, Picton 2571	Ph: 046 - 771326
Wyong	P.O. Box 174, Wyong 2259	Ph: 043 - 531333
Yarrowlumla	P.O. Box 112, Queanbeyan 2620	Ph: 062 - 971311
Yass	P.O. Box 6, Yass 2582	Ph: 062 - 261322
Young	P.O. Box 436, Young 2594	Ph: 063 - 821688
Muswellbrook	P.O. Box 122, Muswellbrook 2333	Ph: 065 - 432866

CITIES AND MUNICIPALITIES

Armidale City	P.O. Box 75A, Armidale 2350	Ph: 067 - 722264
Dubbo City	P.O. Box 81, Dubbo 2830	Ph: 068 - 822211
Glen Innes Mun.	P.O. Box 61, Glen Innes 2370	Ph: 067 - 322611
Gosford City	P.O. Box , Gosford 2250	Ph: 043 - 242811
Grafton City	P.O. Box 24, Grafton 2460	Ph: 066 - 422266
Greater Taree City	P.O. Box 482, Taree 2430	Ph: 067 - 522744
Kiama Municipality	P.O. Box 74, Kiama 2533	Ph: 042 - 321122
Maitland City	P.O. Box 220, Maitland 2320	Ph: 049 - 336200
Orange City	P.O. Box 35, Orange 2800	Ph: 063 - 621555
Shoalhaven City	P.O. Box 42, Nowra 2541	Ph: 044 - 216011
Tamworth City	P.O. Box 555, Tamworth 2340	Ph: 067 - 663641
Wagga Wagga City	P.O. Box 20, Wagga 2650	Ph: 069 - 211088
Queanbeyan City	P.O. Box 90, Queanbeyan 2620	Ph: 062 - 980211
Camden Municipal	P.O. 183, Camden 2570	Ph: 046 - 669221

PASTURES PROTECTION BOARD

Armidale	126-130 Taylor Street, 2350	Ph: 067 - 722366

COMMERCIAL

Bayer Australia	46-67 Wilson Street, Botany 2019	Ph: 02 - 6669841
Ciba-Geigy	P.O. Box 76, Lane Cove 2066	Ph: 02 - 4281966
Dow Chemicals	105 Miller St., North Sydney 2060	Ph: 02 - 9298433
DuPont Agrichemicals	P.O. Box 930, North Sydney 2060	Ph: 02 - 9298455
Monsanto Australia	35 Terry St., Rozelle 2039	Ph: 02 - 820255
Nu-Farm Chemicals	77 Marrs Road, Lane Cove 2066	Ph: 02 - 4270733
Roche-Maag	P.O. Box 59, Bankstown 2200	Ph: 02 - 7095555
East-Coast H'copters	P.O. Box 351, Caloundra, Qld, 4551	Ph: 071 - 914718
Brian Charlton	Big Jacks Ck., Willow Tree	Ph: 067 - 471784
Andrew Kaye	P.O. Box 24, Quirindi, 2343	Ph: 067 - 472055
Des Thwaites	G.P.O. Box 130, Sydney 2001	Ph: 02 - 931157

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